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PROCEEDINGS OF THE AMERICAN ASSOCIATION OF ANATOMISTS
THIRTY-EIGHTH SESSION

Osborn Zoological Laboratory, Yale University, New Haven, Connecticut, December 28, 29, and 30, 1921

WEDNESDAY, DECEMBER 28, 9.30 A.M.

The Thirty-eighth Session of the American Association of Anatomists was called to order by President CHARLES F. W. MCCLURE, who appointed the following committees:

Committee on Nominations for 1922: Professor Alexander S. Begg, Chairman, and Professors H. B. Ferris and C. H. Danforth.

Auditing Committee: Professor Richard E. Scammon, Chairman, and Professor Davenport Hooker.

The remaining morning session was devoted to the presentation of scientific papers.

THURSDAY, 11:30 A.M. ASSOCIATION BUSINESS MEETING, Vice-President T. WINGATE TODD presiding.

The Secretary reported that the minutes of the Thirty-seventh Session were printed in full in *The Anatomical Record*, volume 21, number 1, pages 35 to 41. On motion, seconded and carried, the minutes of the Thirty-seventh Session were approved by the Association as printed in *The Anatomical Record.*

Professor R. E. Scammon reported for the Auditing Committee as follows: The undersigned Auditing Committee has examined the accounts of Doctor Charles R. Stockard, Secretary-Treasurer of the Association of Anatomists, and finds the same to be correct with proper vouchers for expenditures and bank balance on December 20, 1921, of $172.86.

[Signed] R. E. SCAMMON,
DAVENPORT HOOKER.

THE ANATOMICAL RECORD, VOL. 23, NO. 1
JANUARY, 1922

The Treasurer made the following report for the year 1921:

Balance on hand December 29, 1920, when accounts were last audited	$164.40	
Receipts from dues 1921	2,881.86	
Total deposits		$3,046.26
Expenditures for 1921:		
Expenses Secretary-Treasurer, Philadelphia Meeting	$19.10	
Postage and telegrams	50.46	
Printing and stationery	86.74	
Collection and exchange on drafts	4.10	
Stenography, typewriting	49.50	
Paid bank for credit North Dakota check	7.00	
Member Second International Eugenics Congress	5.00	
Wistar Institute, subscriptions to Journal of Anatomy, Anatomical Record, etc	2,651.50	
Total expenditures		2,873.40
Balance on hand		$172.86

Balance on hand deposited in the name of the American Association of Anatomists in the Corn Exchange Bank, New York City.

On motion, the report of the Auditing Committee and the Treasurer were accepted and adopted.

The Committee on Nominations, through its Chairman, Professor Ross G. Harrison, placed before the Association the following nominations for office in the Association: For President, Clarence M. Jackson; for Vice-President, Harold D. Senior; for Secretary-Treasurer, Lewis H. Weed; for members of Executive Committee, terms expiring 1925, Davenport Hooker and Benjamin F. Kingsbury.

On motion, the Secretary was instructed to cast a ballot for the election of the above named.

The Secretary then announced that the election of Lewis H. Weed as Secretary-Treasurer caused a vacancy on the Executive Committee for a two-year term. The President then called for a nomination to fill this vacancy.

Professor Irving Hardesty was nominated and elected to serve on the Executive Committee until 1923.

The Secretary presented the following names recommended by the Executive Committee for election to membership in the American Association of Anatomists:

ADAMS, L. A., Ph.D., Instructor in Comparative Anatomy, *University of Illinois, Urbana, Ill.*

BAST, T. H., B.A., Ph.D., Assistant Professor of Anatomy, *University of Wisconsin, Madison, Wis.*

CAMERON, ANGUS L., M.D., Ph.D., Assistant Professor of Surgery, *Medical School, University of Minnesota, Minneapolis, Minn.*

CALKINS, LEROY A., M.D., Ph.D., Assistant Professor of Obstetrics, *Medical School, University of Minnesota, Minneapolis, Minn.*

DUNN, H. L., M.A., *Department of Anatomy, University of Minnesota, Minneapolis, Minn.*

GATENBY, J. BRONTE, Ph.D., Professor of Zoology, *Trinity College, Dublin, Ireland.*

GEIST, FREDERICK D., M.D., Instructor in Anatomy, *University of Wisconsin, Madison, Wis.*

GREEN, R. B., M.B., F.R.C.S., Demonstrator of Anatomy, *University College, Gower St., London, W. C. 1, England.*

HANSON, FRANK BLAIR, Ph.D., Associate Professor of Zoology, *Washington University, St. Louis, Mo.*

HARWELL, CHAS, S., A.B., M.D., Assistant Professor of Anatomy, Emory University, *435 Euclid Ave., Atlanta, Ga.*

HUNTER, JNO., M.B., Ch.M., Anatomy Department, *Sydney University, Sydney, Australia.*

HUBER, ERNST, Ph.D., Associate in Anatomy, *Johns Hopkins Medical School, Baltimore, Md.*

HOY, WM. E., JR., Ph.D., Professor of Biology, *Presbyterian College of S. Carolina, Clinton, S. C.*

HUMPHREY, RUFUS R., A.M., Instructor in Histology and Embryology, *Cornell University, Ithaca, N. Y.*

LEE, FERDINAND CHRISTIAN, A.B., M.D., Instructor in Anatomy, *Johns Hopkins Medical School, Baltimore, Md.*

MILLER, SHIRLEY P., A.B., A.M., Instructor in Anatomy, *Anatomical Institute, University of Minnesota, Minneapolis, Minn.*

MULL, PHILIP L., B.S., M.D., Instructor in Anatomy, *University of Louisville, Medical Department, Louisville, Ky.*

NITTONO, K., M.D., Professor of Anatomy, *Chiba Medical College, Chiba, Japan.*

NICHOLSON, F. M., Ph.D., Assistant in Pathology and Bacteriology, *Rockefeller Institute for Medical Research, 66th Street and Avenue A, New York.*

ROMER, ALFRED S., B.A., Ph.D., Instructor in Anatomy, *University and Bellevue Hospital, Medical College, 338 East 26th St., New York City.*

RIENHOFF, WILLIAM F., JR., A.B., M.D., Instructor in Surgery, *Johns Hopkins Hospital, Baltimore, Md.*

SMITH, BERTRAM GARNER, A.B., Ph.D., Associate Professor of Anatomy, *University and Bellevue Hospital Medical College, 338 East 26th Street, New York City.*

SMITH, CHRISTIANNA, A.M., Instructor in Zoology, *Mt. Holyoke College, South Hadley, Mass.*

STARK, MARY, Ph.D., Professor of Histology and Embryology, *New York Homeopathic College, New York City.*

STEVENSON, PAUL H., M.D., Assistant in Anatomy, *Peking Union Medical College, Peking, China.*

SISSON, SEPTIMUS, B.S., V.S., Professor of Veterinary Anatomy, *Ohio State University, Columbus, Ohio.*

SYKES, GEO. F., Ph.B., M.A., Professor of Zoology and Physiology, *Oregon State Agricultural College, Corvallis, Oregon.*

UHLENHUTH, EDUARD, Ph.D., Associate in Pathology, *Rockefeller Institute for Medical Research, 66th Street and Avenue A, New York City.*

WHITESIDE, BEATRICE, Ph.D., Instructor in Anatomy, *Washington University Medical School, St. Louis, Mo.*

WOODMAN, A. S., M.D., Assistant Professor of Histology and Embryology, *Boston University School of Medicine, Boston, Mass.*

On motion, the Secretary was instructed to cast a ballot for all the candidates proposed by the Executive Committee. Carried.

The Secretary then announced the following names as dropped from the list of members on account of non-payment of dues for the past two years:

DR. E. A. BAUMGARTNER, Halstead, Kansas.
DR. W. B. CHAPMAN, Washington University, St. Louis, Mo.
DR. ELBERT CLARK, University of Chicago, Chicago, Ill.
DR. FABIO FRASSETTO, University of Bologna, Italy.
CAPT. C. F. SILVESTER, Army Medical Museum, Washington, D. C.

It was announced that the Executive Committee had voted to hold the next annual meeting during Easter week of 1923 in the central part of the country, or Mississippi Valley, the place to be determined later.

The Executive Committee nominated four persons, two of whom were to be elected by the Association for membership on the Journal Committee as organized at the previous meeting. As a result of the election, Professor F. T. Lewis was chosen to serve for five years and Professor H. M. Evans to serve for four years as members of this committee.

It was moved by Professor H. H. Donaldson and seconded, That the Association express to the retiring Secretary-Treasurer its sincere appreciation of his efforts for, and loyalty to, the

Association during his years of service. The motion was approved by a rising vote.

On motion, the business session then adjourned.

FRIDAY, DECEMBER 30. A BUSINESS SESSION followed the morning Scientific Session.

A discussion regarding the publication in the Proceedings of the Meeting of abstracts by persons not attending the sessions was introduced. It was finally resolved that in the future those members not intending to be present at the meeting should send in their communications as to be read by title only. The abstracts of such communications are to be published in connection with the proceedings of the meeting.

Professor G. L. Streeter introduced the following resolution:

RESOLVED: That the Association express to the authorities of Yale University its sincere appreciation of the exceptional facilities and accommodations that have been provided for this meeting, and which have in so large part contributed to its success, and also for the cordial hospitality of Professor Harrison, Professor Ferris, and the members of the local committee that has been so generously extended to all those in attendance.

Unanimously voted.

On motion, the Session adjourned.

CHARLES R. STOCKARD.

Secretary of the Thirty-eighth Session of the American Association of Anatomists.

ABSTRACTS

1. A comparison of the cerebellar tracts in three teleosts. WILLIAM H. F. ADDISON, University of Pennsylvania.

The cerebellar fiber-tracts of three fishes of different habits have been studied, in order to compare the relative sizes attained by each tract in the three species. The three fishes were Gadus morrhua (cod), Arius (a small Siluroid), and Pleuronectes limanda (flounder). Serial sections were studied in the Netherlands Central Brain Institute of Amsterdam, by courtesy of Dr. Ariens Kappers, director. The afferent cerebellar tracts in the teleostean brain are: mesencephalo-cerebellaris anterior, mesencephalo-cerebellaris posterior, lobo-cerebellaris, spino- et olivo-cerebellaris, vestibulo-cerebellaris, and laterali-cerebellaris. The efferent cerebellar tract is the cerebello-motorius, of which the most anterior part is the brachium conjunctivum anterius. Two examples illustrating the nature of the study may be given. The mesencephalo-cerebellaris anterior is largest in cod, intermediate in flounder, smallest in Arius. This tract arises in part from the tectum opticum, transmits impulses from the visual centers, and is largest in the form having the largest visual apparatus. The mesencephalo-cerebellaris posterior is largest in Arius and less well-developed in the other two. This tract arises near the end-station of the lateral lemniscus, probably transmits impulses from the latter, and is largest in the form having the best-developed lateral-line organs. In this way, one may correlate in size the various afferent tracts with the receptors from which they transmit impulses to the cerebellum, and may gain evidence as to the relative part played by the different tracts in the formation of the cerebellum.

2. Growth of the medullary tube grafted into the allantois. (Lantern.) ANNA AGASSIZ and VERA DANCHAKOFF, Columbia University.

The development of the spinal cord manifests a high degree of independence from its continuity with the cranial part of the central nervous system. A number of grafts of blastoderms were made at different stages, beginning with 5 somites. The part of the blastoderm which contained the four or five, sometimes a greater number of cranial somites was severed and the caudal part, containing 1 to 10 somites, grafted into the allantois. That part of the neural tube which had been closed at the time of grafting invariably grows and differentiates in a manner similar to that in which it does normally. It is more difficult at present to conclude whether the ectoderm caudally to the somites will as readily differentiate. Not only does the neural tube differentiate white and grey matter in the graft, but, as demonstrations will show, the grey matter differentiates into ventral and dorsal horns, and even various cell groups in these can be recognized. Interesting data in relation to the migration of groups of nerve cells are obtained, inasmuch as groups of nerve cells are found scattered in the graft through regions of more or less undifferentiated tissue. Nerve trunks grow without reaching the organs they would normally have supplied, as these organs

often fail to develop. Neither continuity with the cephalic part for the differentiation of the spinal cord, nor presence of developing organs for migration of nervous ganglia and growth of nerve trunks seems to be required for growth and development of the nervous tissue in the embryo.

3. The morphogenesis of the hypophysis in the tailed amphibia. Wayne J. Atwell, Medical Department, University of Buffalo.

The hypophysis has been studied in Ambystoma, Spelerpes, Necturus and Amphiuma. The most striking difference between these forms and the Anura previously studied is in regard to the adult condition of the pars tuberalis. As in the Anura this part has its origin from a pair of processes which grow forward from the remainder of the gland. These processes do not become detached to form separate epithelial plaques as they do in the frog and the toad at the time of metamorphosis, but maintain their connection with the anterior lobe throughout life. The anterior lobe proper and the pars intermedia develop as in the Anura except that the adult position of the pars intermedia is dorsal to the anterior lobe rather than caudal to it. The neural lobe is considerably sacculated in Necturus and Ambystoma. Judging from this criterion alone, these two forms are primitive and are rather closely related to certain of the fishes.

4. Autoplastic transplants of the epithelial hypophysis in larvae of Rana pipiens. Wayne J. Atwell, Medical Department, University of Buffalo.

The epithelial hypophysis was transplanted from the head to the tail in very young tadpoles of Rana pipiens. The operated animals failed to develop the typical silvery appearance of the hypophysectomized tadpole. They were, however, lighter in color than normal larvae. Examination of the living tadpole under the binocular microscope shows that the melanophores are not so contracted nor the xantholeucophores so widely expanded as in the typical silvery larva. The appearance is that the hypophysis, or at least the pars intermedia—which is responsible for the color change—has been only partly compensated for by the transplant. The condition is evidently that of a chronic hypophyseal insufficiency. Serial sections show that the hypophysis was completely removed from the head. The region of the transplant in the tail is readily observable macroscopically because of the expanded condition of the melanophores in the immediate vicinity. This probably indicates a local effect of the transplanted gland. Although the transplant was apparently functioning more than four months after the operation none of the tadpoles underwent metamorphosis. Whether this is due to the atrophy of the anterior lobe tissue in the transplants can not be stated because the degree of histological differentiation is not sufficient to permit identification of the separate parts. It is possible, however, to identify two varieties of cells in the transplant, both apparently parenchymal.

5. The increased absorption of x-ray energy by vitally stained white rats. W. M. Baldwin, Union University (Albany) Medical College.

Paramoecia which are vitally stained indicate an increased susceptibility to the action of x-ray energy. This investigation represents an effort to establish a general principle covering the absorption by living tissues of x-ray energy increased through chemical means. The source of this energy was a large Cool-

idge water-cooled tube carrying a load of 50 Mam. at 50 K.V. The rats were placed 17.5 cm. from the center of the target and each was rayed for two consecutive minutes. A dosage of 100 Mam. minutes was sufficient to induce death at an average of from 100 to 120 hours after the exposure. When such vital stains as trypan blue, trypan red, neutral red, isamine blue, etc., were used in an amount not sufficient to affect the vitality of the rats, a dosage of 100 Mam. minutes induced death within from forty-eight to fifty-six hours. This increase in the absorption of x-ray energy conforms to the results obtained by Hertel studying bacteria sensitized to radiant energy of the length of ultraviolet light rays.

6. The sitting height. Based on the measurements of more than 225,000 individuals. R. Bennett Bean, University of Virginia.

Age. Girls are precocious and boys retarded in the growth of the sitting height. The sitting height grows more rapidly at and after puberty than before. It remains stationary from 25 to 60 years and decreases thereafter. The hypophylomorph is retarded and the hyperphylomorph precocious in the growth of the sitting height, and the mesophylomorph is intermediate. The Asiatic has the sitting height accelerated early and retarded late in growth, the growth of the sitting height in the African is late and short, and the European is intermediate. The Asiatic has a long torso and short legs, the African a short torso and long legs, and the European is intermediate, in the adult.

Race and type. We may group the races by type:

Extreme hypophylomorph: Aino, Lapp, Pigmy, Eskimo, Siberian, Aymara.
Hypophylomorph: Southeast Asia. Some negroes and Negritos.
Mesophylomorph: American Indian. Central Asia. Some negroes.
Hyperphylomorph: European, Indo-European, Nordic and derivatives.
Extreme hyperphylomorph: Mediterranean race and related stocks.

Each race has hypo stocks, and some have meso and hyper. The Lapps, Finns, and Ainos are the hypos for Europe, the Alpine and sub-Nordics are the mesos, and the Nordic and Mediterranean are the hypers. The Pigmies are the hypos for Africa, the Central Africans are the mesos and the long-legged Negritos are the hypers. The Siberians and southeast Asiatics are the hypos for Asia, the Chinese are the mesos, and the Thibetans and Japanese are the hypers.

Race movements have altered the type.

7. Contraction rate of the uterine musculature of the rat with reference to the oestrous cycle. Edward W. Blair (introduced by Herbert M. Evans), Department of Anatomy, University of California.

The spontaneous rhythmical contractions of the excised rat uterus (one horn), suspended in warm (38°C.) oxygenated Locke's solution, were recorded by means of a heart lever writing on a long-roll kymograph. The rhythm is found to be slowest at the time of oestrus, increasing gradually to a maximum late in the resting stage, and decreasing rather suddenly at the pro-oestrus. The contraction and relaxation time are little affected, the difference being in the interval between contractions. The rhythm of the resting uterus is often broken by the appearance of superimposed contractions before relaxation is complete. These were ignored in estimating the rate. Barely perceptible minimal contractions are often interpolated between the ordinary maximal contractions of the uterus,

at and near oestrus. These also are ignored in the data tabulated. Age and history of previous pregnancies also influence the rhythm, but do not affect the influence of the oestrous cycle.

SMEAR	NUMBER OF ANIMALS OBSERVED	MEAN INTERVAL BETWEEN CONTRACTIONS	RATE PER HOUR
		minutes	
Small epithelial cells only (Pro-oestrus)	2	2.34	25.6
Small epithelial and cornified cells (Oestrus)	5	2.5	24.0
Cornified cells only (Post-oestrus)	4	1.42	42.3
Leucocytes and epithelial cells (Early Di-oestrous interval)	5	1.06	56.6
Leucocytes and epithelial cells (Late Di-oestrous interval)	2	0.77	77.9

8. *The pancreatic ducts of the white rat.* J. L. BREMER, Harvard Medical School.

The pancreas of the white rat surrounds the hepatic duct throughout almost the entire extent of the latter from liver to duodenum, and is connected with it by numeruos ducts. These all represent ventral pancreas, as the duct of the dorsal pancreas degenerates early. The original relations of liver diverticulum, single ventral, and dorsal pancreas are similar to those in other mammals. Besides these true pancreatic ducts, of varying size, many smaller blind gland-like pockets open into the hepatic duct.

9. *The control of head formation in Planaria dorotocephala by means of anesthetics.* J. W. BUCHANAN (introduced by R. G. Harrison), Yale University.

By mass experiments it is shown that head frequency in pieces of Planaria can be controlled by subjecting the pieces for short periods after section to appropriate concentrations of chloretone, chloroform, chloral hydrate, ether, and ethyl alcohol; that in such concentration of these agents the increase of oxygen comsumption following section does not occur.

The evidence shows that the factors controlling head formation are non-specific and supports Child's conclusions regarding the nature of these factors, viz., that head formation is determined by the relative activities of two antagonistic factors: 1) the tendency of the cells near the anterior cut surface of the piece to de-differentiate and to develop into the head of a new individual; 2) the tendency of the whole of the piece, exclusive of the cells concerned in the development of the new head, to maintain the differentiation of the old individual, exerting a certain degree of control over the cells near the anterior cut surface and tending to prevent the development of a new head.

The facts indicate that anesthetics alter head frequency, 1) by direct inhibition of the processes of development of the cells concerned in the formation of the new head, causing decreases in head frequency; 2) by inhibition of the increase of metabolic activity of the whole of the piece following section; in pieces from

certain regions this effect overbalances the direct effect on the developmental processes of the cells concerned in forming the new head and in such pieces head frequency is increased.

10. The fate of the neuropore in Amblystoma embryos. H. S. Burr, The School of Medicine, Yale University.

A study during the past few years of the early stages in morphogenesis of the cerebral hemispheres in Amblystoma has confirmed the findings of Kingsbury ('20) concerning the rostral relations of the primary columns of His, and indicated the possibility of an experimental solution to the question of the fate of the neuropore. Small wounds made in the ventral lip of the neuropore and stained with nile blue sulphate could be followed for many days during subsequent development. By comparing careful camera lucida drawings of such operated embryos, with median sagittal sections of the same it was possible to locate with precision the ultimate position occupied by the lips of the neuropore. The ventral lip of the neuropore is incorporated into the neural tube as the terminal ridge (Johnson '09). The lateral lips of the neuropore fuse to form the lamina terminalis. It is evident, therefore, that the lamina terminalis is the terminal portion of the roof plate of His which by this fact ends at the terminal ridge. Furthermore, the alar plates forming as they do the lateral boundaries of the roof plate sweep, in the terminal ridge, across the mid line thus bringing the alar plate of one side into direct continuity with that of the opposite side. This means that the mid ventral region of the rostral end of the neural tube is, in Amblystoma, occupied by the alar plate as far caudally as the preoptic recess and not by the floor plate.

From this latter point, the terminus of the sulcus limitans, the mid ventral line of the neural tube as far caudad as the fovea isthmi shows in Amblystoma none of the characteristics of floor plate material. Rather as Kingsbury ('20) has shown in other forms, this region is occupied in the main by nervous tissue which is continuous, in the early stages with the basal plate of the neural tube.

We find in Amblystoma, then, that the rostral relations of the primary columns of His are as follows: The roof plate terminates at the terminal ridge and the floor plate at the fovea isthmi. The alar plates are continuous from side to side in the terminal ridge, and the basal plates in the region from the fovea isthmi to the preoptic recess show a similar continuity.

11. The development of the nasolacrymal apparatus in Amblystoma. H. S. Burr and E. S. A. Robinson, The School of Medicine, Yale University.

An experimental study of the development of the nasolacrymal apparatus in Amblystoma has revealed the following facts. The entire canal, including the superior and inferior lacrymal ducts, is laid down as a thickening of the inner layer of the ectoderm along the bottom of the naso-optic furrow. By proliferation and delamination the thickening develops into a solid cord of cells which begins to separate from the ectoderm at the nasal end. This separation is never entirely completed as the ocular end retains its connection through subsequent growth. Eventually the nasal end of the cord sinks through the mesenchyme of the head to become attached to the nasal epithelium. Lumen formation starts in the solid cord usually at the ocular end by tangential mitoses of the peripheral cells and migration of the central cells into the interstices between the former.

Operations involving the removal of the eye in one series, of the nose in a second, yielded the following results. In each type of operation the removal of the sense organ involved also the removal of the primordium of the lacrymal apparatus since the eye and the nose at this stage of operation are so closely related that the ectodermal site of the apparatus is usually removed when either is extirpated. The absence of either the ocular or the nasal placode associated with removal of the naso-optic furrow results in the absence of these passages, hence neither sense organ is a determining factor in regeneration of the nasolacrymal apparatus. Incomplete removal of the optic-furrow results in partial regeneration of the passages irrespective of the presence or absence of the sense organs.

12. The topography of the abdominal viscera in the late embryonic and the fetal period of man as determined by graphic reconstruction. (Lantern.) Angus L. Cameron (introduced by R. E. Scammon), Department of Anatomy and Department of Surgery, University of Minnesota.

The topography of the abdominal viscera of fifty selected specimens of the latter part of the embryonic and of the fetal period was determined by means of graphic reconstructions with the orthoscopic apparatus and by field graphs of the vertebral levels of the various portions of the abdominal organs.

The transition from the embryonic to the fetal period is characterized by a number of marked changes in abdominal topography. These are completed, in the main, by the close of the third month, and during the rest of the fetal period the relations of the viscera to skeleton and to each other remain remarkably constant. The chief changes in abdominal topography in the fetal period are those of the caecum, splenic flexure and sigmoid flexure. The axis of the spleen is also somewhat modified and the head of the pancreas is depressed.

These results fall in line with the findings of other workers in this laboratory that the growth of the external proportions of the abdomen follows a constant course in the fetal period. The particular changes enumerated above seem to be principally mechanical ones dependent on the distension of the colon with meconium in the latter months of prenatal life.

13. Studies in the dynamics of histogenesis. VII. The experimental transformation of the smooth bladder muscle of the dog, histologically into cross-striated muscle and physiologically into an organ manifesting rhythmicality. E. J. Carey, Marquette School of Medicine.

1. The essential difference between the pale smooth muscle of the bladder and the red involuntary striated muscle of the heart is finally dependent upon the differential intensity of hydrodynamic tensional stimuli (work) to which the vesicular and cardiac mesenchymal cells are subjected, respectively. If the growing vesicular smooth muscle is subjected to a stimulus comparable to that found in the heart, will cross-striated muscle be differentiated? The answer is yes.

2. The evidence presented proves definitely that the pale bladder musculature may be transformed into the red, cross-striated type by increasing the tensional stimulus to a degree comparable with that which the cardiac mesenchyme experiences normally.

3. Muscle tissue is not a self-differentiated product, but is a biomechanical resultant of an optimum tension. The variable intensity of the optimum tension determines the muscular type. The growing cells receive and respond to the mechanical tensional stimulus. The stimulus, however, is a function of position.

4. The evidence herein presented proves that the structure of striated muscle is determined by the function it performs and the work it does and that cross-striated muscle is not formed in anticipation to a future function. The conclusion is warranted that function in this case determines structure, and not the reverse.

14. Transformations of the branchial arteries in man. E. D. Congdon, Stanford University Medical School.

Owing to the subtlety of the changes in the walls of the branchial arteries, there are very few portions of the carotids or of the definitive aortic arch that can with certainty be allotted to specific parts of the branchial system. This is illustrated by the changes taking place after the disappearance of the first and second branchial arteries, when the third, fourth, and sixth radiate upward from a pouch and the primitive external carotid comes off at the junction of the third artery and the pouch. The region of union of the third and fourth branchial arteries and the external carotid is seen to migrate upward. This is apparently due in part to the remolding of the pouch wall into a tube. Perhaps there is also a blending of the lower ends of the two branchial vessels. By a similar process the point of union of the primitive external carotid with the third branchial artery is in turn carried away from the fourth by the formation of an intermediate trunk, the common carotid.

15. The reticular material as an indicator of physiologic reversal in secretory polarity in the thyroid cells of the guinea-pig. E. V. Cowdry, Rockefeller Institute for Medical Research, New York.

In the thyroid glands of normal guinea-pigs, the reticular material (i.e., Golgi apparatus, canalicular apparatus, etc.) is not invariably found between the nuclei and the follicular lumen, as is generally supposed; but in some cases undergoes an active migration to the opposite pole of the cell, which, together with other evidence at hand, indicates the existence of a reversal in physiologic polarity whereby the secretion is discharged directly into the circulation, instead of being first stored within the follicles.

16. Studies on the spleen. R. S. Cunningham. Department of Anatomy, Johns Hopkins Medical School.

a. The rôle of the spleen in experimental hydremia. In two series of experiments on cats hydremic plethora was produced by continued intravenous injection of physiological saline. In normal animals about 40 cc. of fluid collected in the peritoneal cavity before there was any in the pleural or pericardial cavities. In animals whose spleens had been previously removed fluid appeared simultaneously in all three cavities. It was also found that a considerably larger amount of fluid must be injected in splenectomised animals in order to obtain an ascites equal to that produced in normal animals. In contrast to the other abdominal organs the spleen apparently never became edematous even in those

experiments in which large amounts of fluid were injected. The mesothelial cells of the spleen, from animals in which an ascites was developing, were found to contain vacuoles of various sizes. In certain experiments in which iron ammonium citrate and sodium ferrocyanide were injected intravenously granules of Prussian blue were found in these vacuoles. *b. Reaction of the splenic mesothelium to vital dyes.* In animals that had been vitally stained by intravenous injections the splenic mesothelial cells contained the dye in fine perinuclear granules. After irritation the cells became cuboidal and finally columnar, and the granules of vital dye were collected principally in the infranuclear zone of the cell. This location of the vital dye inclusions was very similar to, but considerably less in amount than, that found in the germinal epithelium of the ovary.

17. Grafts in the allantois of embryonic anlages of the chick. (Lantern.) Vera Danchakoff, Columbia University.

Young blastoderms in toto, parts of blastoderms at various stages and chick anlages of different organs, were grafted into the allantois. The earlier a whole blastoderm is transferred to the allantois, the less growth and differentiation is obtained. It seems as if energetic growth of embryonic cell groups can be effected in the allantois only after a definite organization of the embryonic cell material has been completed. Such organization fails to take place in the allantois, if the blastoderm is transferred into it at a stage of early primitive streak, and the growth resulting from such a graft contains only islands of undifferentiated tissue. If, however, the blastoderm is allowed to develop to an advanced primitive streak stage showing a slight indication of the head process and is then grafted the different cell groups grow well and reach a high degree of differentiation.

Among such cell groups it is especially those which develop into kidney, nervous tissue, eye and notochord, which seem to manifest the least disturbing effect from the transfer of the blastoderm into the allantois. The segment stalks develop tubules and Malpighian glomerules, the neural plate differentiates gray and white matter, sends out nerve trunks, and groups of nerve cells migrate far away into various parts of the graft, the visual organ develops pigment and lens; the notochord attains a considerable size and becomes surrounded by cartilage; a cartilaginous envelope is formed around the spinal cord and in this different parts of normal vertebra are recognized.

Separated parts of the blastoderm also grow on the allantois. A curious result was obtained in relation to the pronephros. Blastoderms with 10 and more somite embryos were cut into two parts, between the 8th and 9th somite, and the cranial part with the anterior 7–8 somites grafted. In this case the pronephros seems to attain a more extensive development than that reached by the pronephric anlage under normal conditions.

18. The question of digital homology. C. H. Danforth, Washington University School of Medicine.

The character of a digit appears to be regulated by at least two different factors. One is the tendency of limb-buds to produce terminal lobulations, the other is something in the general nature of gradients between the pre- and post-axial borders. The 'gradients' of the upper and lower limbs are apparently equivalent, but the lobulations do not seem to be so. When the hand and foot are

compared it becomes apparent that, if the digits of the two limbs are considered as equivalent units, many comparable features are nearer the preaxial side of the foot than of the hand. Thus, in the hand the longest digit is the third; in the foot, usually the second. Hair centers for the mid-digital segments are on the fourth finger and the third toe. The Mm. interossei are oriented with reference to the third finger and the second toe. Other muscles and bones show similar tendencies, although less clearly. Simple hereditary syndactyly involves the third and fourth fingers, the second and third toes. Accessory tendons from the preaxial side reach the second finger oftener than they reach the second toe. Tendons to the fifth toe are suppressed more frequently than those to the fifth finger. These facts, with the strongly corroborative evidence from polydactyly, are interpreted to mean that the digits of the hand are not serially homologous with those of the foot, the great toe being equivalent to rather more than the thumb, the little toe to somewhat less than the little finger.

19. Some significant features of the anatomy of a symelian monster (Sympus monopus). Aldén B. Dawson, Loyola University School of Medicine, Chicago.

Ballantyne ('04) has shown that fetuses which have only one umbilical artery almost constantly present the malformation known as sympodia. He believed that the single artery of the cord was vitelline in origin and accordingly concluded that the arterial supply of the placenta must be non-allantoic. In the case under discussion, however, the single umbilical artery appeared to be formed by the fusion of two umbilical arteries. The single trunk took its origin from the aorta a short distance below the superior mesenteric, the inferior mesenteric appearing as a branch of the umbilical. The relatively high origin of the umbilical artery can be explained as a retention of the early embryonic position. Caudally the umbilical trunk gave off a single iliac trunk which divided to supply the fused lower limbs.

There were no genito-urinary or anal apertures. Both testes were present, but the right was undescended. Their vasa deferentia opened into the blind end of the digestive tract. The right kidney was absent. The left was rudimentary, and its ureter opened into the left vas. Both suprarenal glands were present and their arterial supply was of the embryonic type.

The caudal end of the vertebral column was suppressed and the spinal cord extended the entire length of the canal, i.e., to the level of the fourth sacral vertebra. The segmentation of the thoracic region was disturbed. Extensive fusion occurred in the pelvic girdle. There was a single median femur, a single median fibula and two lateral tibiae.

The anomalies which are constant for this group of monsters will be described in detail, and their developmental significance discussed.

20. The standardization by empirical formulae of the data on surface area in man and animals. H. L. Dunn (introduced by R. E. Scammon), Department of Anatomy, University of Minnesota.

This study is limited to a consideration of the recorded data on the surface area of man and animals. The material obtained was analyzed graphically and its expression developed by the use of empirical formulae.

The animals in which the relation of body weight to surface area has been determined are cattle, guinea-pigs, rats, rabbits, frogs and lizards. However, the data on these forms are not sufficient to permit a comparison with human material. In man the relationship of surface area to body weight, body length and time in years has been studied by four classes of methods: *a*) the paper and mould methods which are the most accurate since they closely approximate the surface; *b*) the geometric method, which is only of approximate accuracy; *c*) the linear method of DuBois based on empirical measurements; *d*) the photographic method of Benedict which involves the application of DuBois' linear formula to photographic silhouettes.

Conclusions: 1) The results of the paper and mould methods must be regarded as the most reliable. 2) The curve of the central tendency of all data on the relation of surface area to body weight in man may be expressed by the general empirical formula: $Y = 0.02\ X^2 + 3.9\ X + 10$ in which Y is square decimeters, X kilograms, and 10 is an empirically determined constant.

21. The azurophile granulation of the lymphoid cells of the blood during digestion and fasting and in relation to the tributaries of the venous system. V. E. Emmel, Department of Anatomy, University of California.

A quantitative study of the azurophile granulation in the lymphoid cells of the circulating blood of the rat was made with reference to digestion and fasting, together with a comparative analysis of the blood in the tributaries of the venous system with the following results:

First. That in any given animal under constant physiological and dietary conditions the percentage of lymphoid cells showing azurophilic granulation, as tested for the peripheral circulation from day to day, is relatively constant. Second. In animals fasting for 24 to 90 hours there is a decrease in the percentage of azurophile granulation followed by a pronounced increase during digestion. Third. In animals under normal physiological conditions the inferior cava, superior to the hepatic veins, constantly gave a higher percentage of azurophile granulation as compared with the superior cava. Fourth. Upon analysis of the tributaries of the inferior cava, the portal vein was found constantly higher in the percentage of azurophile granulation than that of the abdominal part of the inferior cava; the latter being practically equal to that of the peripheral circulation. Fifth. On the other hand, in fasting animals this difference, with respect to the portal vein, largely disappeared, so that the azurophile granulation for the portal vein was now essentially the same as that of both the peripheral circulation and the inferior cava inferior to the hepatic veins. Sixth. The above differences based upon the percentage of the total number of lymphoid cells containing azurophile granulation is further confirmed and emphasized by corresponding differences in the numerical content of azurophile granules within these cells.

A further analysis of the tributaries of the portal system, together with the effect of different diets, is under investigation.

22. The percentage of polychromasia in the blood of the rat as correlated with gestation, lactation, and the oestrous cycle. V. E. Emmel and J. E. Walker, Department of Anatomy, University of California.

In a number of mammals a certain percentage of the erythrocytes in the circulating blood, normally show a polychromatophilic reaction to basic dyes. As this polychromasia is especially pronounced in the rat, it has been utilized as an index in determining to what extent there may be an interaction between the activities of the reproductive system and the cellular elements of the blood in this animal. The present stage of this investigation shows the following results:

A. Successive blood tests for any given normal male or non-pregnant female gave a relatively constant percentage of polychromasia. B. In female rats, during gestation, there was a definite rise in the percentage of polychromasia. This increase was further accentuated during lactation. In both instances, this increase appeared most pronounced in the earlier phases of these stages. C. Fluctuations in the total erythrocyte count seemed, in general, to correspond with these changes in the percentage of polychromasia. D. A control series of non-pregnant animals failed to show changes corresponding to the pregnant and lactating animals. E. In tests made during the oestrous cycle the percentage of polychromasia was always slightly higher at the pro-oestrous stage and correspondingly lower at the following di-oestrous stage. F. In a series of observations on postnatal changes in the blood of three males the percentage of polychromasia gradually declined from an average of 21.3% at birth to 5.1% on the 56th day. This is suggestive of a correlation between the postnatal reduction in polychromasia with the attainment of sexual maturity—a conclusion which remains to be confirmed by further investigation.

23. On an invariable and characteristic disturbance of reproductive function in animals reared on a diet poor in fat soluble vitamine A. Herbert M. Evans and Katherine Scott Bishop, Department of Anatomy, University of California.

Studies herein reported confirm the impression that rats may be successfully reared on diets poor in vitamine A if the diet is not too deficient in this essential. They may for months grow normally and not suffer from the so-called xerophthalmia. It must be admitted that we have not had previously a method for the detection of deficiencies in this vitamine which, nevertheless, permit good growth and apparent health. Studies on the oestrous cycles of such rats show them to suffer from an invariable and continuous abnormality or disfunction of the ovaries.

It has previously been shown in this laboratory that ovulation in the rat can be detected in the living animal by a series of histological changes in the vaginal smear, changes which are correlated with the growth, maturation and rupture of the graafian follicles at periodic intervals. When for any reason the follicles are unable to completely mature (as in animals treated with hypophyseal substance) the vaginal oestrous changes are absent. If follicles develop but are unable to rupture, the oestrous changes may be remarkably prolonged, and the dioestrous pause, in fact, obliterated. As Evans and Long have shown, this occurs as a rare anomaly in large colonies of animals. But this prolongation of oestrous vaginal changes and failure of ovulation occurs in 100 per cent of animals

reared on diets which are low in vitamine A but which nevertheless permit normal growth. We have used typical diets employed by E. V. McCollum and by T. B. Osborn and L. B. Mendel, in which the chief fat content was furnished by lard. On the administration of small quantities of dried, powdered leaves of young succulent alfalfa or of small quantities of butter fat, this characteristic abnormality in oestrus and ovulation was cured.

24. Oestrus and ovulation in the rat, from a large group of animals on a standard diet. HERBERT M. EVANS and KATHERINE SCOTT BISHOP, Department of Anatomy, University of California.

It is important to know what might be expected to be the normal oestrous behavior of animals reared from the time of weaning on a satisfactory standard diet. For this purpose we have employed a standard ration used by E. V. McCollum, consisting of whole wheat, whole milk powder, casein, salts and 5 per cent butter fat. Many animals have been maintained on this ration as litter mate controls of animals on other nutritive regimens, so that there is available for these data the performance of over five hundred individuals. The growth exceeds considerably that reported by other investigators as normal. Daily microscopic observations were made on the vaginal smears. The average time of occurrence of the first oestrous cycle in the group was on the forty-seventh day of life.

Occurrence of first oestrus in 570 individuals

AGE IN DAYS	NUMBER OF INSTANCES	PER CENT
32–36	18	3.1
37–55	459	80.5
56–66	73	12.8
67–94	20	3.5

Length of oestrus cycle in 10,000 instances

(First four cycles in each history are omitted)

LENGTH OF CYCLES IN DAYS	NUMBER OF INSTANCES
3	72
4	3,494
5	3,943
6	1,439
7 and over	1,052
	10,000

General average: 5.4 days.

It will be noted that the sexual maturity of these animals which were maintained on a superior nutrition is precocious when compared with the standards known to the literature. In the majority of cases of exceptionally early maturity

there is a superior growth rate. It is also true that the slowest growers usually mature later. The latter statement is firmly established by our work (not presented here) on quantitative and qualitative under-nutrition which invariably delays sexual maturity.

An examination of the normal curve of growth with reference to the time of establishment of ovulation shows that the rate of growth does not change with this event.

25. Characteristic effects upon growth, oestrus, and ovulation induced by the intraperitoneal administration of fresh anterior hypophyseal substance. HERBERT M. EVANS and JOSEPH A. LONG, University of California.

At the last session we reported acceleration of growth in rats treated daily intraperitoneally with the finely ground, fresh anterior lobe of the hypophysis of beef. There is lack of effects from oral administration of the same substance. Treated animals are invariably heavier than their litter mate sisters. The greatest disparity was attained on the 333rd day of life, when an animal receiving anterior hypophyseal substance weighed 596 grams and its healthy litter mate control weighed 248 grams. It would not appear to be incorrect to characterize these changes as producing constantly a mild degree of gigantism. Increase in weight results to a great extent from a storage of fat, but is not solely due to this, the skeleton being invariably somewhat larger and heavier, and, as would be expected, the heart, lung, alimentary canal and kidney are heavier. The weight of the hypophysis, thyroid and thymus are not appreciably affected.

Oestrus, as detected by typical changes in the vaginal smear, may never occur in these animals or may be exhibited only at long intervals. In all instances the ovaries instead of being underdeveloped weighed twice as much as the control and exhibited great numbers of substantial corpora lutea. The uterus, on the contrary, weighed absolutely about half as much as it did in the normal controls. Histological examination of the gonads showed abundant lutein tissue and demonstrated the formation of this tissue about the egg in unruptured, normal follicles and in atretic follicles. Ripe, normal Graafian follicles were invariably absent. A powerful, specific stimulus to lutein cell transformation has thus been effected by this hormone.

26. A strain of epithelial cells in pure culture. (Lantern.) ALBERT FISCHER, (introduced by E. V. Cowdry), Rockefeller Institute for Medical Research.

By cultivating in vitro parts of the chick embryo lens containing cells from the iris, a pure outgrowth of epithelial cells was successfully obtained. The strain was derived from a little rim of iris which spontaneously adhered to the lens when removed. It has been cultivated for more than two months, and is still proliferating in a way which is characteristic of epithelial growth in vitro. No connective-tissue cells have been observed. The culture medium is the same as has been used for cultivating fibroblasts, but by allowing the cells to multiply on the surface, instead of in the plasma clot, a more extensive growth has been observed. The rate of growth of epithelial cells in vitro is less active than that of fibroblasts, but the number of cultures can be multiplied easily.

27. Preliminary results of rotation of portions of the embryonic spinal cord about its long axis. DAVENPORT HOOKER, University of Pittsburgh School of Medicine.

Previous studies have demonstrated the possibility of reestablishing anatomical and physiological continuity between completely severed portions of the embryonic spinal cord in normal and reversed polarity when the original dorsoventral relations of the components are maintained. The power of the various parts of the cord to reestablish proper connections in cases of poor apposition of the cut ends led to experiments on the reestablishment of continuity between severed segments of the embryonic cord of Rana and Amblystoma when one segment was rotated on its long axis.

The results of preliminary experiments indicate that it is possible to obtain reestablishment of continuity between a normally oriented cord component and a segment which has been rotated on its long axis through various arcs up to complete inversion (180° rotation). The restoration of physiological continuity has not been conclusively demonstrated. Better healing and continuity of like areas of the cord is obtained when the segment is rotated up to 90° than when rotated more. When rotated 90°, there is a tendency for the regenerated tissue closing the cord wound to rotate through the quarter turn of a spiral to link up the like cord areas. This same tendency is present in rotations of from 90° to 135°, but is not so clearly demonstrable. In at least one case of 180° rotation, there is definite evidence of a motor and sensory fiber decussation in the sagittal plane. There is thus a definite interattraction of like areas of the cord.

28. A note on the ectodermal origin of the spinal ganglia. DAVENPORT HOOKER, University of Pittsburgh School of Medicine.

The results of the writer's experiments in total removal of the nervous system in frog embryos at the time of closing of the neural folds have been criticized by Dart and Shellshear on the ground that the operation necessitated the removal of the dorsal portions of the myotomes from which, according to these investigators, the cells of the spinal cord and ganglia are at least in part derived.

It is practically impossible to remove the entire nervous system in frog embryos at the stage in which the neural folds have just closed without some injury to the myotomes. It is possible to remove the dorsal half of the spinal cord, the neural crest and the covering ectoderm at this stage without the slightest injury to the myotomes. This was done, in the belief that the absence of all nervous elements in the total removal experiments in conjunction with the presence of the majority of myotomic elements proved the ectodermal origin of the ventral horn cells and made it necessary to review only the possible myotomic origin of spinal ganglia elements.

The results of the removal of the dorsal half of the cord, of the neural crest and the ectoderm show that the amount removed is in direct proportion to the size of the spinal ganglia developing, if any. Where little was removed, the ganglia are complete; where the cut went deeper, they are smaller; and where the entire mass was removed, they are absent. The myotomes contribute no elements.

29. The relation of the thyroid to certain stages of metamorphosis in frog larvae. Margaret Morris Hoskins, University of Arkansas.

The experiments described were made by E. R. Hoskins in 1919, in order to test a theory of the relation of the thyroid to different stages of metamorphosis. It was our belief that the influence of this gland on metamorphosis was through its effect on calcium metabolism. In its absence the skeletal changes do not occur and the lack of these first steps towards the adult form prevents the later changes such as the atrophy of the tail and the shortening of the intestine. In the experiments made in 1919, the thyroid anlage was taken from its normal position and grafted into the tails of the larvae. When the animals had reached their maximum size and had well-developed legs, the tails containing the thyroid grafts were cut off. With few exceptions these thyroidless animals completed metamorphosis. Examination of sections has been made to eliminate all cases in which thyroids regenerated in the normal position, and it was found that although a large percentage of regeneration was present, a number of the frogs were actually thyroidless. It is therefore evident that the thyroid is not directly necessary for the later stages of metamorphosis.

30. Meningeal relations of hypophysis cerebri. Walter Hughson, Department of Anatomy, Johns Hopkins Medical School.

Although many workers have commented upon the meningeal investments of the hypophysis, no adequate description of these membranes has been presented. Study of serial sections of this region shows that in addition to the dural covering of the floor of the sella turcica, the hypophysis is completely surrounded by an arachnoid membrane continuous with that of the brain. Similarly the pia is reflected upon the hypophysis investing it closely. Between these two membranes is a space, traversed by many trabeculae so that it becomes close-meshed.

The continuity of this leptomeningeal space about the hypophysis with the cranial subarachnoid space has been demonstrated by two methods of injection. In both of these procedures, injections of a true solution of iron ammonium citrate and sodium ferrocyanide were made into the spinal or bulbar subarachnoid space, with subsequent precipitation of the foreign salts in situ. The first method involved the injection of the solution under rather high pressures; in the second the introduction of foreign solution was accomplished by the reduction of the cerebrospinal fluid pressure by simultaneous intravenous injection of strongly hypertonic solutions of sodium chloride. Under these conditions of injection the precipitated prussian blue granules have been found to surround the hypophysis in a definitive subarachnoid space. In addition these granules may be traced into the substance of the hypophysis itself, entering by way of perivascular channels into the stroma of the pars buccalis and outlining more or less completely the cellular cords. Likewise into the substance of the pars nervosa granules may be similarly traced. In both cases, absorption into the capillary bed seems indicated.

31. Observations on the femur. N. W. Ingalls and M. H. Grossberg, Laboratory of Anatomy, Western Reserve University.

The possession by the Hamann Museum of a pair of femora of great interest and extreme rarity has directed attention to certain variations in the distal

half of the femoral diaphysis. The femora in question are characterized by their great length and especially by the very marked increase in the transverse diameter of the lower part of the shaft. While these specimens are frankly pathological, the evidence from normal bones seems to indicate that the condition just noted is only a very aggravated case of normal growth disturbance, although the etiological factors may not be the same. A rather extended series of measurements carried out on 100 pairs of femora from male whites between the ages of 18 and 86 shows, among other things, considerable variation in the width of the inferior half of the femoral shaft. Although none of the bones of this series approach in degree of deformity the pair which occasioned the investigation, they show earlier and milder stages of what appears to be a similar process, i.e., an increase in the width of the lower half of the shaft. In well marked cases there is a gradual increase in transverse diameter beginning about the center of the diaphysis, the lower half of the bone is unusually massive and the condyles consequently appear less prominent. The normal processes of growth and remodeling in this part of the bone seem to be especially sensitive or vulnerable. Somewhat similar, but more irregular deformities in this region have been supposed to be of endocrine, possibly thyroid, origin.

32. Changes in body length and in weights of the body and of various organs in atrophic infants. C. M. Jackson, Institute of Anatomy, University of Minnesota.

Clinical history and autopsy data for twelve cases of death from inanition were used. Ages range from 5 to 255 days; final body weights, 1695 to 3972 grams; body lengths, 47 to 64 cm. In most cases, the data are fairly complete and comparison (using Scammon's norms) permits the following conclusions:

1. The height-weight index (metric) averages 0.0165, range 0.0120–0.0205 (Bardeen's normal, 0.254).

2. The loss in body weight, final compared with maximum recorded during life, averages 19.2 per cent (range 13.7 to 25.5 per cent).

3. The loss in body weight, final compared with normal for corresponding body length, averages 28.5 per cent (range 7.4 to 52.3 per cent). The loss estimated on this basis is greater, due to persistent skeletal growth.

4. The retardation in growth, final body weight being compared with normal for corresponding age, averages 56.8 per cent (range 41.6 to 71.6 per cent).

5. The changes in weights of the individual organs have been calculated, each observed weight being compared with the normals estimated as the corresponding values for, 1) the final body weight; 2) the maximum body weight; 3) the final body length, and, 4) the age. In general the normal weights are progressively greater for these four estimates, with corresponding differences in the relative (percentage) changes in the organ weights.

6. Omitting consideration of the individual organs, it may be stated that the results are in general agreement with those obtained by experimental inanition on animals. The differences may be due partly to the small number of cases and to existing complications in the atrophic infants.

33. Secretory phenomena in pathological human thyroids. J. Albert Key, Harvard Medical School.

In hyperactive thyroids the mitochondria and secretion antecedents are increased and can be studied. In a series of fifty pathological thyroids I have studied the mitochondria and secretion granules and vacuoles.

The secretion granules, first differentiated from the mitochondria by Bensley, are round, variable in size and usually in the apical zone of the cell. They are soluble in alcohol, blackened with osmic acid, and are fixed and stained by mitochondrial techniques. They differ from mitochondria in that they are more resistant to acetic acid and are stained by methyl-green, neutral gentian and other stains which do not stain mitochondria.

The secretion vacuoles first seen by Wyss, and termed chromophobe secretion by Anderson, are apparently identical with those described by Bensley. They are variable in size, most abundant in the apical zone of the cell, and appear as clear vacuoles in formalin-bichromate or osmic material. By Bensley's formalin-zenker and brazilin-wasserblau method the vacuoles deep in the protoplasm are preserved and contain a thin coagulum which stains light blue, but the ones in the apical zone are destroyed.

The mode of secretion seems to be that the granules and vacuoles are cast into the vesicle and lose their identity, the granules being dissolved in the fluid like contents of the vacuoles and the mixture forming the colloid which passes back between the cells to be taken up by the lymphatics or blood vessels. The density of the colloid is determined by the relative proportion of the two constituents. The vacuoles are markedly increased in the hyperactive glands and cause the colloid to be thin and contain large vacuoles.

The granules may or may not be increased and their rôle is apparently to form a thickening menstruum to hold the active constituent (contained in the vacuoles) in the vesicles. The mitochondria are definitely increased in hyperactive glands but apparently have to do with the general metabolism of the cell and are not the direct antecedents of the secretion. All three appear to arise independently in the cytoplasm. The colloid cells are senile cells and intracellular colloid droplets are evidence of hypofunction.

34. Peripheral migration and distribution of cells from the cerebrospinal nervous system in embryos. Albert Kuntz, St. Louis University School of Medicine.

In embryos of the chick in which the neural crests and the dorsal portions of the neural tube are destroyed by early operation the primordia of the sympathetic trunks arise exclusively from cells of medullary origin which advance peripherally along the paths of the ventral roots of the spinal nerves. Migrant medullary cells also become incorporated in the neurilemma of efferent nerve-fibers. These facts were demonstrated at the last meeting of the American Association of Anatomists.

Further experimental studies indicate that the majority of the cells which become incorporated in the primordia of the sympathetic trunks advance from the intermediate portions of the lateral walls of the neural tube.

In embryos in which the peripheral migration of cells from the cerebrospinal nervous system is prevented throughout the trunk region by early operation the primordia of the oesophageal, pulmonary, cardiac, and enteric plexuses arise

exclusively from cells which advance peripherally along the paths of the vagi. On the other hand, an embryo in which the portions of the hind-brain from which the vagi arise and the greater portion of the vagus ganglia were destroyed by early operation shows complete absence of the primordia of the sympathetic plexuses related to the vagi although the primordia of the sympathetic trunks and the prevertebral plexuses are present.

35. The innervation of the lung of the rabbit. O. Larsell, University of Oregon Medical School.

The bronchial tubes are innervated chiefly by the homolateral vagus, but fibers from the contralateral nerve also have a part in each lung.

The larger bronchi are surrounded by two nerve plexuses. One, composed of relatively large fibers, many myelinated, lies external to the cartilaginous plates. Numerous clusters of ganglionic cells are distributed throughout this plexus. Unmyelinated axonic processes from these cells become arranged into bundles of small size which form a second plexus between the bronchial muscle and the plates of cartilage. The individual fibers subdivide and terminate on the smooth muscle cells. Frequently accompanying these bundles are larger myelinated fibers which lead to sensory terminations in the bronchial epithelium.

In the smaller bronchi the two plexuses become intermingled so closely that only one may be said to be present. Relatively few ganglion cells are found beyond the secondary bronchi, so that the plexus of the smaller bronchi consists chiefly of postganglionic fibers and sensory fibers, whereas the extracartilaginous plexus of the larger bronchi consists chiefly of preganglionic fibers and sensory fibers.

The pulmonary blood-vessels, including the bronchial artery, have a well defined plexus of nerve fibers which terminate in the smooth muscle cells of the tunica media of these vessels.

Myelinated nerve fibers and small nerve terminations, apparently of sensory type, are also present in the pulmonary pleura.

36. Empirical formulae for the growth curves of the various organs and systems of the single-comb White Leghorn chicken. H. B. Latimer, University of Nebraska.

Empirical formulae for the growth curves of one hundred single-comb White Leghorn chickens ranging in age from day of hatching to three hundred days, with six between one and two years old, have the general formula; $Y = (aX)n \pm bX \pm c$. Y represents the weight of the organ, in grams; a, b, c and n are fixed constants, empirically determined, and X represents the gross body weight in grams. The entire growth curve for some of the organs may be represented by this formula with slight variations of the constants for each curve, and at least the first part of all the curves can be so expressed.

For the organs with a curve which is convex superiorly at first "n" is a decimal fraction. This group includes most of the organs such as the brain, spinal cord, eyeballs, kidneys, etc. In the formula for the thyroid gland, feathers and musculature "n" is greater than unity and the resulting curve is concave superiorly in at least the first part of the curve. The formula for the growth of the integument (without feathers) and for the ligamentous skeleton is a straight line at first.

The upper or terminal portion of many of the curves is a straight line, represented by the general formula $Y = a(X - b) + c$, in which a, b and c are the constants and X the gross body weight.

A sex difference is shown in the growth curve of the feathers and the ligamentous skeleton.

37. Studies on the retina. Histogenesis of the visual cells in Amblystoma. Henry Laurens and Samuel Randall Detwiler, Yale University and Pekin Union Medical College.

The first stage in the development of the visual cell is the production of a protoplasmic bud and a clear achromatic globule from the cells of the external nuclear layer. The globule, which becomes the paraboloid of the inner segment, appears to be of cytoplasmic origin. In early stages of the visual cells, masses of deeply staining granules are seen in iron-haematoxylin preparations. These granules contribute mainly to the formation of the ellipsoid of the inner segment and to the granular material of the outer segment. There is no evidence from our preparations which indicates that they are products of pigment ingested from the epithelial layer. They may represent transformation products of mitochondria. In early stages of development, the visual cells are all cone-like, agreeing in this respect with the conditions characteristic of the developing amphibian retina. Rods and cones are later differentiated from the primitive, non-specialized visual cells. Rods do not appear in their definitive form until relatively late. The two kinds of conical-shaped visual elements are regarded as visual cells of low specialization which develop, respectively, into characteristic rods and cones by divergent differentiation.

38. Studies on the ligation of the thoracic duct. F. C. Lee (introduced by Lewis H. Weed), Department of Anatomy, Johns Hopkins Medical School.

a. The establishment of collateral circulation. An operation was devised for the intrathoracic ligation of the thoracic duct in the cat. Subsequent injection of the mesenteric lymphatic vessels while the animal was under an anesthetic showed that two types of collateral circulation were established. One group consisted of those cases in which branches came off of the thoracic duct below its point of ligation and then joined the right thoracic duct. In one animal this connection was seen as a fine branch seven days following ligation; while in another animal which was sacrificed seventy-seven days after ligation, two large trunks coursed to the right thoracic duct. The other group included those cases in which a lymphatico-venous connection was established between the thoracic duct and the azygos vein or its branches. *b. Changes in the number of small lymphocytes in the circulating blood.* Blood counts and smears were made from a series of animals in which the duct had been tied, and it was found that the absolute number of small lymphocytes decreased about sixty per cent immediately following ligation, but that the number gradually returned to normal at the end of three weeks. Examination showed that a collateral circulation had been established.

39. A. On the influence of symmetry in development, with special reference to the aortic arches of the sheep. B. Lantern slides to illustrate the derivation of the term 'hippocampus,' with preparations by Prof. P. E. Lineback. FREDERIC T. LEWIS, Harvard Medical School.

'Nature abhors a vacuum' is a discredited medieval maxim, serviceable as it was in its day. With similar limitations it may be said that Nature is ill at ease—restless—in the presence of asymmetry, thus expressing a milder reaction, subsiding into apparent contentment when conditions are irremediable. Two examples of this situation, one from plants and one from animals, will be presented. The flowers of Campanula rapunculoides, with parts in fives except the carpels, which are three, show many variations interpretable as readjustments. Frequently by the addition of a sixth sepal, petal, and stamen symmetry is restored. A most striking instance in mammalian embryos is the almost complete restoration of a new symmetry, after the first has been destroyed, in the aortic arches of the sheep. The transformation of these vessels has been studied by Dr. G. H. Jackson, Jr., whose results, in part, I am permitted to report. Wax reconstructions of embryos of 10, 14, 15.8, 18, and 47.5 mm. have been made.

If the attainment of symmetry may be regarded as an end in nature, subsequent changes in the great vessels in the pig would seem possible, and the human aortic arches are perhaps further from their ultimate arrangement than those of either pigs or sheep. Such considerations, at least, make it possible to suggest morphological changes in the development of the human body, which, in the course of time, may yet be brought about.

40. Is mesenchyme or smooth muscle a syncytium or an adherent reticulum? WARREN H. LEWIS, Carnegie Laboratory of Embryology.

Conclusive evidence on this point cannot be gained from fixed, stained and sectioned material; on the other hand, cultures indicate that the cells of these tissues unite not as a syncytium, but as an adherent reticulum, often similar to that seen in the embryo. One can follow the slow shifting of the cells, the withdrawal of processes from neighboring cells and the sending out of new ones to the same or other cells. Processes attached to the cover-glass only, behave the same as do those attached to neighboring cells except that the former are often more firmly adherent. The processes of mesenchyme cells tend to extend out in all directions and can often be followed in outline (even in fixed cultures) onto neighboring cells or cells beyond these. The processes of smooth muscle cells are usually longer and more pronounced at the two poles and may extend for long distances. There is no evidence of the transfer of material from one cell to another. Both types of cells often become entirely isolated at the periphery of the outgrowths from the rest of the reticulum, their processes being attached solely to the cover-glass. Hypertonic solutions, glycerin and other reagents may cause cells of a reticulum to round up and lose all connections with neighboring cells. In one type of degeneration a similar effect is produced. A renewal of the favorable medium may cause the cells again to expand into an adherent reticulum. Daughter cells do not remain permanently attached to each other.

41. Survival of cells after death of the animal. Warren H. Lewis and C. C. McCoy, Johns Hopkins Medical School.

All cells live for a period after death. Most of them develop granules and vacuoles which have an affinity for neutral red. When the cells die the color disappears from the granules and vacuoles and the nuclear wall becomes marked. With neutral red as a testing agent various tissues of the rat were examined in spreads. In organs kept at 37°F. large macrophages, cartilage cells, kidney epithelium and smooth muscle, survived for 240 hours; bladder, trachea, tongue and salivary gland epithelium, 192 hours; lymphoid cells and endothelium, 168 hours; lung epithelium, 144 hours; Kupffer cells and leucocytes, 120 hours; sertoli, liver and pancreatic cells and brain macrophages, 96 hours; mesenchyme, ovarian follicular, uterine epithelial and gland cells and red blood corpuscles, 72 hours; and epididymis epithelium, 48 hours. Small pieces of tissue left at room temperature in Locke's solution with neutral red exhibited living macrophages at 144 hours; bladder, tracheal and salivary gland epithelium, smooth muscle and cartilage cells, at 120 hours; mesenchyme and endothelium at 72 hours; ectoderm, lymphoid cells, uterine, pancreatic and lung epithelium, at 48 hours; adrenal cells and leucocytes, at 24 hours; epididymis and intestinal epithelium, ovarian follicular, liver and fat cells, at 18 hours; red blood corpuscles, male germ cells and sertoli cells, at 12 hours. When the entire animal was left at room temperature the periods of survival were much shorter. Nerve cells usually die before granules and vacuoles have a chance to form. Striated muscle always stains diffuse pink.

42. Studies on the nerve supply to the colon: First showing in the early stages with a model of a 23-mm. embryo. P. E. Lineback, Emory University, School of Medicine.

A study of the appearance and early nature of the nerve supply to the colon, following closely the work done on its musculature, seems logical. This is all the more advisable since the study of both the nerves and muscles in the older, fuller formed state will be greatly facilitated by working with the two simultaneously.

Knowledge of the muscle-nerve mechanism of the colon is of a general sort; it being commonly accepted that the nerves are entirely derived from the sympathetic system. Lynch and Draper have suggested that there might be some degree of nerve control in the caecal end of the tube derived from the mesenteric plexuses, hence a vagus admixture.

In conjunction with the above unsettled point there is the problem of the detailed distribution of the nerves to the saccules and taeniae. It has been shown that independent segmental contraction occurs in the three rows of saccules and it is reasonable to infer that there is an independent nerve supply to each. Such details are lacking in the literature and it is the purpose of the author to pursue this line of investigation, beginning with the earliest appearance of nerves in the embryo.

As shown by the 23-mm. model two large nerves grow out from the hypogastric plexus and extend along the tube, forward. These are more prominent and advanced than those from the mesenteric plexuses in the caecal end. This is in harmony with the origin and line of growth of the muscles.

43. The effect of the ablation of the superior cervical sympathetic ganglia upon the continuance of life. M. Laurence Montgomery (introduced by P. E. Smith), Department of Anatomy, University of California.

In a recent paper Meltzer has stated that the cat and rabbit usually die within a few days if both superior cervical sympathetic ganglia are ablated. Evidence derived from transplantations inclined this author to believe that these ganglia elaborate a principle peculiar to themselves and which is essential to the life of the animal. I have tested this point in a total of eighteen animals, in the rat, cat, and rabbit. All my animals, save one cat, survived the ablation of these ganglia. The cats and rabbits were tested for the presence or absence of these bodies by the 'paradoxical' eye reflex of Meltzer. It is true that the majority of such animals give this reaction. At the autopsy performed when the animals were sacrificed fourteen to sixty-eight days after the operation the tissue at the site of operation was removed, later being serially sectioned and examined histologically. No superior sympathetic ganglionic tissue was present in most cases. This shows that these bodies are not essential to life in these animals and that they do not elaborate an essential secretion peculiar to themselves.

44. A preliminary report on a radiographic study of the position of the stomach and other abdominal viscera in healthy young adults. Robert Orton Moody and R. G. Van Nuys, University of California, and W. E. Chamberlain, Leland Stanford Junior University.

This study of three hundred students, an equal number of men and women, shows that in 90 per cent of the women and 81 per cent of the men, in the erect posture, the most caudal part of the greater curvature of the stomach is caudad to a line connecting the highest part of the iliac crests (interiliac line).

The most cephalic position found of this part of the greater curvature is 6 cm. cephalad of the interiliac line and the most caudal position 12 cm. caudad to this line. Dividing this distance into quarters, the position of the most caudal part of the greater curvature is shown in the following table, + indicating the distance in centimeters cephalad and − indicating the distance caudad to the interiliac line.

	+ 6 to + 1.5		+ 1.4 to − 3		− 3.1 to − 7.5		− 7.6 to − 12	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Males.....	16	10	53	35	60	40	21	14
Females..	9	6	45	30	58	38	38	25
Total...	25	8	98	32	118	39	59	19

These results indicate that a low position of the stomach is normal in young adults. It is not ptosis and is not a frequent cause of poor health.

It is also found that, contrary to common belief, the strength of the ventral abdominal musculature and the depth of the lumbar curve are not significant factors in the determination of the position of the stomach.

This problem includes a study of the physical factors that may modify the position of the abdominal viscera. A report on additional cases will be made later.

45. Studies of the estrous cycle in the ox. H. S. Murphey, Iowa State College.

A. Diestrum: Os circular, vagina comparatively dry, very few epithelial cells, practically no leucocytes.

B. Estrum: Pro-estrum: 1. Bright cherry-red color of vestibule due to congestion of bulbus vestibuli. 2. Enlargement of vaginal part of cervix due to swelling of or ripening of mucous cells. 3. Beginning of the outpouring of mucus from the cervical canal. 4. Slight swelling of the vulva. Estrum (or heat): 1. Signs:—bawling, uneasiness, depression of lumbo-sacral articulation; on digital manipulation of clitoris, receptive movements. 2. Swelling of vulva. 3. Vestibule deep red to mahogany. 4. Involuntary contractions of vestibular sphincter. 5. Os uteri, a transverse slit. 6. Great swelling and protrusion into the vagina of the folds of mucous membrane of the cervix. The folding is more marked, and arranged in three to four rows—in old cows mostly two encircling rings—while in virgin heifers mostly one and a half rings. 7. A marked outpouring of clear, viscid, cohesive mucus.

Post-estrum: 1. A sudden cessation of estrum or heat manifestations. 2. A gradual cessation of the anatomical changes. The vulva becomes wrinkled. The deep color of the vestibule remains relatively longer; the enlargement of the cervix gradually subsides; mucus is discharged from the os for two or three days. The vaginal mucus is streaked with or shows white flocculi, later it becomes gummy, sticky and cohesive, it is opalescent. The white material is both epithelial cells and leucocytes. The former are vaginal in origin as are most of the leucocytes; however, some of the latter are present in smears made directly from the os. Microscopically the cells show increasing degeneration step by step with the gumminess of the mucus.

Diestrum:

Estrum: Uterus: 1. Marked congestion. 2. Edematous, glassy, mucous membrane folded in hillock fashion. 3. Petechiae on both the cotyledonous and intercotyledonary mucous membrane.

46. Dorsal and ventral implantation of the limb bud. J. S. Nicholas, University of Pittsburgh School of Medicine. (From the Osborn Zoological Laboratory, Yale University, and the University of Pittsburgh.)

The limb bud has been transplanted to the ventral and dorsal midlines in order to test the rules of limb asymmetry. The growth of the limb so implanted is seldom typical and the limb is generally resorbed.

The two cases in which limbs developed, one in the ventral and one in the dorsal location, gave rise to two perfect limbs. These cases are in accord with Harrison's rules for limb behavior, for under the conditions of implantation the limb bud was located half on the right and half on the left side of the animal. The limbs are morphologically complete in every respect. The girdles of the two limbs are fused, the central portion being common to both members.

The ventral limbs are innervated apparently by the rami supplying the ventro-lateral musculature. There is no increase in the peripheral distribution of the

normal nerves from the plexuses of the normal limbs. Below the dorsally implanted limbs numerous mitoses are found in the cord which shows definite hyperplasia. The sensory ganglia are found dorsal to their regular location. This hyperplasia and displacement of the sensory ganglia cannot be said to be due to operative defect, for other animals in which the limb resorbed were operated in the same manner but no hyperplasia exists in any of the cases so far examined. It may be assumed that there has been a definite influence exerted by the limbs developing in the dorsal location which has caused hyperplasia.

47. The effect of the rotation of the area surrounding the limb bud. J. S. Nicholas, University of Pittsburgh School of Medicine. (From the Osborn Zoological Laboratory, Yale University, and the University of Pittsburgh.)

Since it has been shown that the limb bud tends to recover its normal posture during its development after the rotation of the embryonic rudiment, the next step is to locate the factors which take part in the process of recovery.

By using a double operation with the rotation of the area surrounding the limb bud, the relationships of both the normal limb area and the surrounding portions have been tested. The complete operative disc is five somites in diameter, of which the central three and one-half somites are occupied by the limb bud.

The results of these operations show that in the course of development, the area surrounding the limb bud controls the postural relationship of the developing limb. The limbs produced are normal except for the posture which they assume. When the limb bud is oriented normally with reference to the embryo, but the surrounding tissue is rotated, the limb is rotated during its development so that it assumes its posture with reference to the surrounding area and not to the organism as a whole. This occurs in both the orthotopic and heterotopic locations, thus showing that the factors causing the rotation of the limb are located in the area normally surrounding the limb.

Further experiments will be carried out to show definitely the development of the parts which are located in the area surrounding the limb and also to show the specific influence of the individual components during the course of their development.

48. An anthropometric study of a group of Syrians in the United States. G. J. Noback, Medical College of Virginia.

This study was made with the object of determining the physical characteristics of one of the peoples of recent migration to the United States. The lack of this information regarding the Syrians led to this study in Minneapolis and St. Paul. One hundred and thirty individuals were measured, of which ninety-four were male and thirty-six were females. Their ages ranged from sixteen to sixty-five years.

The technic and measurements follow closely those practiced in the anthropometric work of the Smithsonian Institution (Hrdlicka, '21). Twenty-two measurements and ten other observations were made on each individual, and ten indices were determined.

Most of the individuals were from the Lebanon and were from mountain and plain. It is believed that our conclusions apply to all of the middle third of Syria.

In stature this group of people is medium-tall according to the classification of heights by Martin and are 2.7 above the world average of Bean. The skeletic index is 52.9; i.e., 2.9 above the index for the world. The cephalic index is 87.5; i.e., Brachcephalic and 7.5 above the world average of Bean. The nose is Leptorrhine, index being 65.4, and 14.6 less than world average of Bean. The facial index is 91.5; i.e., Leptoprosopic. The nose is straight or slightly convex in 94 per cent of the cases; the hair color is brunette in all but one (pure blond) case; the eyes predominantly brown though there are four pure blue and eighteen with some degree of blueness.

The teeth show a poorer condition in those born in the United States on comparison with a similar age group of those born in Syria.

49. On the ossification of the cartilages of the human larynx. G. J. Noback, The Medical College of Virginia.

Previous to Chievitz ('82) it was believed that ossification of these cartilages did not occur before middle life. Investigators were divided as to its significance. Some believed it a normal development, others that it had some relation to disease. Chievitz stated that it was a normal process and that ossification of the laryngeal cartilages is present in all males over twenty, and in all females over twenty-two years of age. Scheier ('01) states that it is a normal process beginning at the same time in both sexes and that he observed ossification in a girl nineteen years old. Text-books follow Chievitz mainly, though some state that this ossification appears at twenty-five years and others that it appears after middle age.

Material used in this study consists of 34 cadaver larynges cleared with KOH and 13 cadaver larynges of which x-rays were made, x-rays of the cervical region of 33 individuals in normal health, and x-rays of 48 persons with chronic tuberculosis.

The present study shows that ossification in the laryngeal cartilages may occur earlier than previously believed. It is demonstrable in the x-ray picture of a boy of seventeen years and in that of a girl of the same age.

Since those individuals showing earliest ossification have chronic tuberculosis and since individuals with this disease show more frequent and extensive ossification of the laryngeal cartilages it seems that chronic diseases may have an intimate relation to ossification of these cartilages.

50. Nerve supply of atria of the bovine heart. James W. Papez, Cornell University.

The bovine atria are supplied by the right and left vago-sympathetic nerves.

The right atrial nerves, three in number, enter along the left wall of the superior vena cava. 1) The largest branch enters the triangular fossa in the atrial septum dorsal to the interatrial band and divides into two. The ventral one (interatrial n.) has a small enlargement from which several filaments are given to the interatrial band, two passing to the left end and one to the right end of the band. The dorsal one (septal n.) has a small enlargement which gives filaments to muscle bundles that radiate from the septum into the walls of both atria. 2) The dorsal branch (right sinus n.) supplies filaments to the musculature of the superior vena cava and in the intercaval region it has an enlargement which gives filaments to the intercaval bundle and muscle bundles around the orifice of the

inferior vena cava. 3) A communicating branch passes dorsal to the right pulmonary veins to form a loop with the left sinus nerve which gives filaments to the dorsal wall of the left atrium and ventricle.

The left atrial nerves enter along the left horn of the sinus venosus (left superior vena cava). 1) The ventral branch has an enlargement at the base of the atrial appendage which distributes filaments to the musculature around the base of the appendage and toward the septum. 2) The lateral branch is distributed to the left and dorsal surface of the atrium. 3) The dorsal branch is distributed along the wall of the left horn of the sinus and communicates with a loop of the right nerve.

51. Structural factors contributing to acoustic insulation of the end organ. A. G. Pohlman, St. Louis University.

The diaphragm-rod theory of sound transmission as presented in part at the past two meetings is opposed to the commonly accepted physiology of the middle and inner ear complexes. The usual theories assume a displacement factor in the perilymph as the activating agent, whereas the writer contends for a direct activation of the auditory cells by the sound pulse itself. Accordingly, the conception of end organ response demands an interpretation on the basis of sound pulse activation. Evidence will be submitted which points to the following: First, that the sound pulse enters the scala vestibuli through diffraction. Second, that the diffracted sound pulse is damped by the relatively small opening through which it passes from the vestibule. Third, that the spiral course of the cochlear structure further limits the amount of energy reaching the region of the helicotrema. Fourth, that the membrana basilaris acts in part as an insulator against the discharge of sound pulses from the otic capsule into the end organ. Fifth, that the vestibular membrane tends to limit the amount of energy transmitted from the scala vestibuli into the cochlear duct.

This conception therefore assumes that the auditory epithelium occupies a relatively sound-proof area except to energies entering through the footplate. It also takes into account the considerably greater energies required to hear the low-pitch tones. It explains the failure of acoustic insulation against high-pitch tones of considerable intensity.

52. The effects of ultraviolet rays on developing mollusks (Limnaeus). C. W. M. Poynter, University of Nebraska, Omaha.

A mercury vapor lamp was used and the apparatus so arranged that the light came from below which permitted the free use of the microscope for continuous observation. Pond snails are particularly adapted for this type of investigation not only on account of their penetrability and excellent visibility but also because their early motility and later heart beat make it possible to study the early effects of sub-lethal doses of the ray.

It must be kept in mind that embryos are more sensitive to the rays at some periods of development than at others if quantitative observations are to be made. From the study of the lethal effects of the rays on a large number of embryos of the same age it was found that the range of resistance within the group was greater than the resistance of the weakest members.

A comparison of short non-lethal doses with continuous cytolizing doses suggests that one of the effects of the light is to form a phototoxic substance which is cumulative in its effects. These animals do not show a greater heat sensitivity from raying; although they die when placed in higher temperatures it can be shown that it is not because of a specific heat action. The effect of the rays in small doses is frequently spoken of as stimulating, but in this work it seems quite certain that the stimulus is catabolic in character. These animals do not present the same recovery curve reported for parameciae. Very small doses of the ray produce a wide variety of monsters.

53. Differences in the time of developments of centers of ossification in the male and female skeleton. J. W. Pryor, University of Kentucky.

"The bones of the female ossify in advance of the male. This is measured at first by days, then months, then years" (American Journal of Anatomy, 1907). The above observation was made after the study of five hundred and fifty-four roentgenograms of the hands of children from three months to fourteen years of age. Two hundred of these were under seven years of age. The conclusion was based on the development of centers of ossification in the bones of the carpus; in the epiphyses of the metacarpals, phalanges, and the distal extremity of the radius and ulna. Comparisons were made between brother and sister; twins of the same sex; twins of the opposite sex and the average of male and female hands of the same age. With these findings in view and the conclusions accurate, the first centers of ossification appearing in the embryo would be in the female.

Mall states the first centers of ossification develop in the clavicle at the sixth week. He did not make a distinction between the male and female. It is probable these early centers were in the female. The conclusions in this paper are based upon the study of roentgenograms of one hundred and forty foetuses from ten and one-half weeks to thirty-eight weeks of age, of which seventy-one were male and sixty-nine were female; and one hundred new born babes from a few hours to ten days of age, of which forty-eight were male and fifty-two were female. Very few of the foetuses were under twelve weeks and the early centers could not be compared. The principal points to be compared were the centers of ossification of the calcaneum, the talus, the cuboid in the tarsus, the epiphyses of the distal extremity of the femur, the central extremity of the tibia and centers of ossification of the capitatum and hamatum of the carpus.

54. The distribution of acid cells on the dorsal wall of the stomach. H. E. Radasch, Jefferson Medical College.

In a previous paper the distribution of acid cells along the greater, lesser and ventral curvatures was carefully worked out. At that time the distribution along the dorsal curvature was not recorded. Thinking that the distribution here might afford some connection with the more prevalent occurrence of gastric ulcer upon the dorsal wall, a special study was made of the distribution of acid cells here.

The average distance along the lesser curvature (from the cardiac orifice) of all human stomachs studied is 63.09 per cent. The average distance along the greater curvature of all human stomachs is 83.29 per cent. The average distance along the ventral curvature is 76.45 per cent. In reference to the dorsal curva-

ture, the average distance from the cardiac orifice that the acid cells extended was 82.76 per cent.

In comparing these distances, it will be seen that the acid cells extend farther along the greater curvature than along the ventral or dorsal curvatures, while the acid cells do not extend along the dorsal curvature to quite the same extent as along the ventral curvature. The areas along these curvatures at which the acid cells cease represent a plane that is not set at a right angle to the axis of the gastric canal, but slopes from the lesser curvature caudad and to the left; the plane as a whole faces cephalad and slightly dorsad.

55. Antidromic conduction considered anatomically. S. W. Ranson, Northwestern University Medical School.

Bayliss has shown that the vasodilator fibers for the limbs run through the dorsal roots and have their cells of origin in the spinal ganglia. He believes that they are sensory fibers with side branches terminating on the blood vessels, and that these fibers conduct afferent impulses centrally and vasodilator impulses antidromicly. This conception has received strong support from the work of Bruce, Bardy, Richardson and Wyatt, Januschka, and Krogh. But it has not been proven that the dilator impulses leave the spinal cord by way of the sensory fibers of the dorsal roots and it must not be overlooked that fibers of unknown origin and function enter the spinal ganglia and terminate about the spinal ganglion cells in pericellular plexuses which are practically identical with those found in sympathetic ganglia. It is quite possible that the pericellular plexuses represent the synapses between preganglionic and postganglionic vasodilator neurons.

The theory of antidromic conduction as stated by Bayliss does not allow for any synapse of sympathetic character; but it can easily be shown by the use of nicotine that there is such a synaptic interruption in the vasodilator path. Plethysmographic tracings taken from the hind leg of the cat show that the vasodilator reflex which can normally be obtained by central stimulation of the vagus nerve is eliminated by suitable doses of nicotine. Whether this interruption occurs in the spinal ganglion or at some other point remains to be determined.

56. On the time and mode of transition from the fetal to the postnatal phase of growth in man. (Lantern.) Richard E. Scammon, Department of Anatomy, University of Minnesota.

The growth of the human body exhibits quite different characteristics in the fetal and the postnatal divisions of the developmental period. The results of a quantitative study of the transition between these phases indicate that the changes which occur may be grouped in two quite distinct classes. The first are the true natal changes associated directly with the shift from intrauterine to extrauterine life. These include modifications in the suprarenals, uterus, stomach, lymphoid tissues and lungs, and the postnatal weight loss and recovery. These changes have certain characters in common: they occur immediately after birth, are of short duration, and take place regardless of the age of the fetus when born. Despite these natal changes the growth of the body as a whole appears little affected by birth and the general course of prenatal growth con-

tinues for some time thereafter. This is demonstrated by the projection by formulae of fetal growth curves into postnatal life and their comparison with observed findings for infants in the same period. It is also indicated by the study of the weight increment curves of premature children in early infancy. The true transition from the fetal to the postnatal course of growth takes place through a second series of changes, much more gradual than the natal changes, which occur mainly in the third trimester of the first year of postnatal life.

57. A quantitative study of the growth of the human eyeball and optic nerve. Richard E. Scammon and Ellery L. Armstrong, Department of Anatomy and Department of Ophthalmology and Oto-Laryngology, University of Minnesota.

The growth in volume of the eyeball in the fetal period agrees very closely with that of the brain-stem and spinal cord. The growth of the diameters of the eyeball is also very like the lineal growth of the brain-stem and spinal cord and may be expressed by the same general empirical formula: $Y = a\ [(bX)^c \pm d]$, where Y is the dimension in question, X the body length and a, b, c, and d are constants. The postnatal growth of the eyeball follows more closely that of the cerebrum than that of the brain-stem or spinal cord. The postnatal growth in volume of the eyeball seems to have been distinctly overestimated; our data indicate that the postnatal gain is not over 150 per cent. The eyeball diameters increase 35 to 40 per cent in postnatal life. In the latter part of fetal life the temporal segment of the eyeball grows more rapidly than the nasal segment. The fetal growth of the diameters of the cornea is not like that of the eyeball as a whole, but resembles the growth of the external dimensions of the body. It may be expressed by the general empirical formula for external dimensions: $Y = aX \pm b$ (symbols as in formula above). The postnatal growth of the cornea approaches more closely that of the eyeball, although it is not entirely similar. The fetal growth in length and diameter of the optic nerve bears a simple relation to the increase in body length and may be expressed by the formula just quoted.

58. The growth of the skeleton in the fetal period as illustrated by a quantitative study of the human mandible. R. E. Scammon and S. J. Z. Ganz, Department of Anatomy, University of Minnesota.

The lineal growth of the human mandible in the fetal period was determined by measurements of 14 dimensions on a series of about 100 specimens. The calculation of the changes in mass were based upon a series of observations by Corrado. These data show that the lineal dimensions of the fetal mandible increase in a direct relation to the growth in the total body length and may be expressed by the general empirical formula: $Y = aX \pm b$, where Y is the dimension in question, X is the body length and a and b are constants. The growth in weight of the mandible, when plotted against body length, forms a typical weight or volume curve expressed by the general empirical formula: $Y = aX^b + c$, where Y is mandible weight in grams, X is body length in cm., and a, b, and c are constants. The various angles of the mandible are extremely variable throughout the fetal period but show no marked change. Thus the mandible, despite its peculiarly intimate relation with the dental follicles, follows the simple laws which are found to be characteristic of the fetal growth of the external bodily

dimensions and of the various parts of the body. Since this holds true for the mandible and is also true for lineal dimensions taken between external bony landmarks it seems safe to conclude that the lineal growth of the skeleton and its parts in the fetal period is proportional to the lineal body growth and that the mass increase of the skeleton follows the same course as the body as a whole, its main parts and the major viscera.

59. The genetic interpretation of abnormalities in the anatomy of the nasolacrimal passageways. J. Parsons Schaeffer, Jefferson Medical College.

From a genetic viewpoint the abnormalities in the anatomy of the nasolacrimal passageways appear to fall into three more or less clearly defined groups: First those that have their basis in rudiment potentials; second those due to early arrests in the development of parts which should proceed from the stem rudiment; and third those due to division of previously continuous parts of the nasolacrimal passageways into discontinuous segments.

Rudiment potentials are encountered which explain such abnormalities as supernumerary lacrimal ducts for one or both eyelids, duplication or triplication of the lacrimal punctum, the slit lacrimal punctum, mucosal ledges and so-called valves within the nasolacrimal passageways, irregularities of contour, diverticula, variations in the anatomy of the lacrimal aperture in the inferior nasal meatus, etc.

Patients are encountered with one or both lacrimal ducts wanting in whole or in part, the connection with the inferior nasal meatus may be defective or wanting, atresias of portions of the nasolacrimal passageways are rather common in the newborn. The cause for the failure of normal development is not clear. So far as the lacrimal ducts are concerned there appears to be a critical period for them shortly after the detachment of the solid epithelial rudiment of the nasolacrimal passageways from its surface connection. If the lacrimal ducts, which normally grow as secondary sprouts from the stem rudiment, fail to show beginning growth shortly after this stage, there appears to be a great likelihood they they will not develop subsequently.

60. The smooth musculature of the afferent veins, and the innervation of the human suprarenal gland. Hubert Sheppard, Atlanta Medical College, Emory University.

The central adrenal vein in man contains a greater amount of smooth muscle tissue than other veins of corresponding caliber. A distribution of the muscle fibers in the afferent veins as well as in occasional accessory veins is peculiar in that most of the fibers are longitudinal and often project into the lumen of the vessels in a rugose or valve-like manner. Only a thin layer of circular fibers can usually be observed lying beneath the endothelium. Nerve plexuses in the capsule distribute to both the cortex and the medulla. Within and about the smooth musculature of the central vein, and in the other veins where smooth muscle is present, minute ganglia with occasional isolated nerve cells are found. The longitudinal fibers projecting into the lumen of the vein are abundantly supplied with minute nerve terminals. Fibrils, exceedingly fine and varicose, also penetrate between and supply the cells of the medullary epithelium. In view of the relation of epinephrin to anaphylactic shock, this abundant smooth muscu-

lature of the afferent veins in the human suprarenal as well as the delicate nerve supply in both the smooth musculature and the medulla would seem to have a direct physiological and clinical significance.

61. Vital staining of human and mammalian blood, with special reference to the separation of the monocytes. MIRIAM E. SIMPSON (introduced by Herbert M. Evans), Department of Anatomy, University of California.

Studies on living blood cells and vital dyes reported at the last meeting of the Association have been brought to completion. (On the reaction of the living blood cells to dyes. M. E. Simpson, Proc. Amer. Assoc. Anat., Anatomical Record, 1921, vol. 21, p. 82.) At that time it was pointed out that certain dyes (especially neutral red, Nile blue sulfate, and brilliant cresyl blue) stained a characteristic set of granules in blood cells termed the segregation granules or segregation apparatus, and furthermore that in this way the monocytes could be separated from the lymphocyte cells. The test has been applied extensively to the blood cells of experimental animals (rabbits) as well as to human material in view of the fact that the tests previously employed to separate these cells in human blood (the Giemsa stain and the oxydase reaction) may be notoriously unreliable with other mammalian blood.

The low content of lymphocytes in the segregation granules and the exceptionally high content of monocytes enables us to separate these cells. Lymphocytes possess from one to eight segregation granules, and in rare instances a few more than this. They contain on the average but three or four of these structures. In the monocytes the granules are always numerous, forty to sixty being a reasonable estimate of the number. The granules can be seen in fresh unaltered living cells without the use of dyes and are especially striking in dark field observations, but they are rendered clearest by supra-vital dyes which accentuate the segregation apparatus. Intermediate types between lymphocytes and monocytes are rare.

62. Indirect Wallerian degeneration not found in all animals. SUTHERLAND SIMPSON, Cornell University Medical College, Ithaca, New York.

The so-called retrograde degeneration, frequently found in some of the fibers in the central end of a divided nerve, is termed by Van Gehuchten 'indirect wallerian degeneration' and is accounted for by him as follows: When the motor root of one of the cranial nerves is divided by a sharp knife all the peripheral fibers, of course, undergo degeneration, but if the animal be kept alive for thirty or forty days after the operation some degenerated fibers may also be demonstrated by the Marchi method in the central end. If instead of making the lesion with a sharp knife he tore out the nerve, i.e., injured it as much as possible, then Van Gehuchten found that all the fibers in the central as well as the peripheral end underwent degeneration. When a nerve fiber is divided its cell of origin reacts and undergoes some degree of chromatolysis which is at its maximum in ten to fifteen days. If the lesion is made with a sharp knife the reaction is less marked, the cell recovers, never having ceased to function as a trophic center for the fiber, but, on the other hand, when the damage is very severe, it does not recover and at a certain stage in its downward course it is no longer able to act as a nutritive center to the fiber and from that time the latter undergoes Wallerian

degeneration. On repeating this work on the rabbit—the animal which Van Gehuchten used—the author is able to corroborate, but fails to obtain similar results in other species.

63. A new classification of the pigmented tumors based on the cytology of the pigment cells. David T. Smith, Johns Hopkins Medical School.

A study of sections from over 300 pigmented tumors from all parts of the human body has shown that these growths may be classified according to whether the tumor cells have produced the pigment or have taken it in as a foreign body. I. True pigmented tumors, in which the pigment is produced by the cells: These pigment granules are always individual, discrete bodies, all of about the same size, shape, and color in a given cell. True pigment tumors arise from pigmented cells belonging to two types of tissue—epithelium and mesothelium. The first type of cell is found in the skin and in the retina. In tissue cultures of the chick these pigmented cells grow as a membrane. They give rise to ordinary benign pigmented moles and to melanotic carcinoma (malignant melanoma). The second type of cell is long and spindle-shaped, with branched processes resembling the chromatophore of the lower animals. It occurs in the choroid of the eye, in membranes of the brain, along the nerve trunks, and in the core of the hair bulb. In chick tissue cultures these cells grow like connective tissue. They give rise to a second type of benign pigmented mole and to malignant melanotic sarcoma. II. Pigmented tumors, in which the pigment is not native to the cell but is taken in as a foreign body, as may be seen in the xanthomata and also in any tumors into which hemorrhage has occurred. In these cells the individual particles of pigment are irregular in size and shape and generally much larger than in the true pigmented tumors, in some instances almost filling the cell. It is evident that cells may sometimes be found in tumors of group I which contain foreign pigment having an origin similar to that found in cells of group II, but cells containing native pigment never occur in the tumors of group II.

64. The effect of intraperitoneal injection of fresh anterior lobe substance in hypophysectomized tadpoles. Philip E. Smith and Irene P. Smith, Department of Anatomy, University of California.

As is well known, the early ablation of the buccal component of the hypophysis in the tadpole results in a well marked alteration in the pigmentary and endocrine systems, and in a slowing of the growth rate. The feeding of the fresh anterior lobe to these specimens brings about a nearly normal rate of growth, but does not bring to normality the altered pigmentary system, the specimens remaining typically albinous, nor do the internal secretory glands respond to this dietary regime, the thyroid failing to develop normally, the parathyroids being diminished in size, and the adrenal cortex diminished and atypically placed. These specimens do not metamorphose. Evans and Long have shown that the intraperitoneal injection of fresh anterior lobe substance in the normal rat produced a growth rate greatly in excess of the normal. Following their lead, we have tried the intraperitoneal injection of this substance in the hypophysectomized tadpole. Such injections bring about a striking change in the larvae so treated. The pigmentary and endocrine systems as well as the growth rate respond to this treatment. The animals become as dark as the normal but exhibit a slightly

more reddish tone. The adrenal cortex and thyroid do not exhibit the great reduction in size which they characteristically display in the typical albino. These animals reach a size much in excess of the normal. They completely metamorphose. From this it would appear that the successful treatment of individuals suffering from hypophyseal deficiency must be affected by the injection of the active principle of this gland and not by feeding, the treatment now resorted to and which has proven almost uniformly unsuccessful.

65. The basic anatomical problem presented by achondroplasia and other unusual structural complexes. CHARLES R. STOCKARD, Cornell University Medical College.

Achondroplasia and certain other peculiar structural conditions occurring in man and higher vertebrates are known in particular cases to be inherited through the *male* parent. This fact renders it probable that achondroplastic individuals arise fundamentally from new or strange chromosomal complexes. Several investigators have recently been inclined to interpret such conditions as due to some unusual activity on the part of glands of internal secretion. This interpretation is, in a sense, very probably true but a fuller consideration is necessary to determine the actual basic cause of the conditions.

Among lower mammals hybridization seems particularly disposed to give rise to such forms and in man this process may also play a part. The specimens in point are most common among chickens and dogs the breeds of which are often derived from more than a single wild species. In short, achondroplasia and similar conditions must be thought of as fundamentally genetic in origin. A mutation occurs and the resulting individuals are in no sense deformed specimens of the common norm.

In the hybrid and mutant individual a unique chromosomal organization was established at fertilization and following development each cell of the body is a new thing containing this strange chromosomal complex. Two propositions now present themselves; they are not antagonistic, and either one or both may be looked upon as explaining the new structural product. As the first possibility, the strange cellular complex of the developing animal may respond in a novel and definite way to the influence of usual or ordinary internal secretions, or in the second place, new and peculiar kinds of secretions may result from the mutation and the presence of these strange substances during development may cause deviations from the racial type, or finally, a combination of these two possibilities might readily obtain. A new breed thus occurs which is capable of perpetuating its characters and is a definite morphological entity or type. These conditions are considered in some detail.

66. Some notes on the migration of neural crest cells in Rana palustris. L. S. STONE, Yale University, School of Medicine.

This is a preliminary report of work in progress on normal and operated anuran embryos. Considerable similarity has been found in the wandering of neural crest cells of Rana palustris and Amblystoma punctatum. However, in Rana palustris the crest cells are well defined before the closure of the neural folds and operations involving the removal of these cells must be confined to this period, for at the closure of the folds the crest cells have already begun a rapid ventral

migration. The crest cells are not so easily followed in the earlier stages as in Amblystoma. They form the entire visceral skeleton. The removal of neural crest cells in the branchial region produces on that side an absence of the hyobranchial plate, ceratohyal, ceratobranchials and the corresponding half of the basibranchial. There is no contribution of entodermal mesenchyme to the visceral skeleton as in the case of the second basibranchial of Amblystoma. The anterior portions of the trabeculae are also formed from neural crest cells. A considerable portion of the connective tissue about the oral region as well as connective tissue in the regions of all the visceral bars is apparently derived from the neural crest.

67. Significance of the fossa triangularis and cymba conchae. G. L. Streeter, Department of Embryology, Carnegie Institution of Washington.

The fossa triangularis and the cymba conchae are part of the same structure and constitute an important articular surface of the cartilage of the auricle. As seen from a median view, they form in common a rounded eminence which is closely apposed to the side of the skull, being loosely attached by a fibrous ligament. This articular eminence is strengthened and better support is given to the auricle by the inferior crus of the anthelix, which projects into it as a sulcus from the median side and divides it into halves. The crus helicis takes part in the formation of the antero-lateral margin of the eminence.

68. Hyperpigmentation and so-called blue skin. R. M. Strong, Loyola University School of Medicine..

In some cases of hyperpigmentation of human skin essentially no melanin pigment occurs in the epidermis. Numerous melanophores are present, however, in the dermis, especially in the papillae. Such cases, so far as known to the writer, exhibit so-called blue skin. No pathological conditions have been found associated with this pigmental abnormality, though intestinal disorders have preceded in the few cases where the history was available. In ordinary negro skin, there is a brownish tint which is lacking in these dermal pigmentation cases. Epidermal melanin occurs in the form of more or less distinctly separated brown granules. They are responsible for a brown tint. Similar granules occur in the dermal melanophores, but they are so clumped as to appear as a more or less definitely black mass. These melanophores give essentially no color to the light emerging from the skin. A dark gray results which lacks the familiar brownish tint and appears relatively blue. Black mixed with small amounts of white in the color wheel gives a similar affect. Carbon particles and other black foreign bodies inserted in the dermis also produced this appearance. If a real blue tint appears, the turbid medium hypothesis is the best explanation at present available for the blue component.

69. The fate of the cells contained in the various quadrants of the primitive limb disc. F. H. Swett, Osborn Zoological Laboratory, Yale University.

Owing to the totipotence of the fore-limb rudiment of Amblystoma punctatum, it is impossible by simple extirpations to determine the portions of the limb formed by the various quadrants. Implantation of markers was attempted without result and the following method was devised. The mesoderm was stained

by heavily overstaining the animals intra vitam with Nile blue sulphate; the limb region was then covered with normal ectoderm, and anterior, dorsal, posterior, and ventral 'halves' of such limb rudiments were transplanted to corresponding positions in normal individuals. As the color remained visible until the division between the first two digits had appeared, it was possible to trace the cells to their ultimate positions in the limb. The anterior half contributes to the lateral side of the base, encroaching on the radial border and less on the extensor surface. The dorsal half contributes to the entire limb except the extreme anterolateral prominence of the shoulder. The posterior half contributes to the entire flexor surface and to the dorsum of the tip. The cells of the ventral half are distributed to the most anterolateral prominence of the shoulder and on the body wall ventral to the limb. Thus: 1) The anterodorsal quadrant forms the proximal part of the dorsal surface and radial border, also proximal parts of the shoulder. 2) The dorsoposterior quadrant forms the manus and distal part of the fore arm. 3) The posteroventral quadrant forms the proximal part of the flexor surface and contains cells which remain in the body wall. 4) The anteroventral quadrant contributes to the formation of the shoulder, but most of its cells do not enter the limb.

70. Interrelation of thyroid and pituitary in producing metamorphosis. W. W. Swingle, Osborn Zoological Laboratory, Yale University.

Transplantation of the pars anterior of adult frogs into immature larvae (R. clamata) with undifferentiated and physiologically inert thyroids, induces rapid growth and differentiation of the limbs, and eventually metamorphosis providing the graft survives. The thyroid apparatus of grafted animals reveals a marked development of the glands; they are larger than those of the controls and composed of large well-formed vesicles. Thyroids of control larvae remain comparatively undifferentiated with scanty colloid content. Pituitary grafts stimulate differentiation and physiological activity of the thyroids. The effect on body growth varies to such an extent interpretation is uncertain; in general results are negative.

Thyroids of large neotenous tadpoles (extra season R. clamata, with hind legs 12 mm. long) transplanted into immature 33 mm. larvae without limb buds, induces precocious metamorphosis within thirty-five or forty days, yet such thyroids when left unmolested in the neotenous individuals produce no metamorphic change in the same time interval. In fact such animals commonly pass an extra winter and spring in this stage. The experiment indicates that their thyroids are active and capable of inducing metamorphosis. Obviously, something hinders the release of the fully formed hormone into the blood stream of neotenous larvae. The data suggests some defect of interrelation of the thyroid-pituitary mechanisms. The statement that thyroid transplants from neotenous anurans into undifferentiated larvae induce metamorphosis only up to the stage reached by the larva from which the glands were taken is true only when the time interval is compared with that required by transplanted thyroids of newly metamorphosed frogs to transform similar individuals, other conditions being equal.

71. Absence of monocytes in thoracic duct lymph. George W. Thorne and H. M. Evans, University of California.

The method of vitally staining leucocytes for the recognition of the monocytes as a distinct mononuclear cell class worked out in this laboratory by M. E. Simpson, has been applied in a study of the thoracic duct lymph. Inasmuch as the normal proportion of monocytes in the blood is low it would appear that the examination of lymph should be carried out in animals in which the proportion of monocytes has been experimentally increased; this may be secured by intravenous treatment of rabbits with some of the benzidine dyes. The monocytes constitute about 8 to 10 per cent of the leucocytes in normal rabbits. The animals were injected intravenously with aqueous solutions of 20 cc. of 1 per cent Niagara Blue at five day intervals. A monocytosis of 20 per cent or more has usually resulted. The vital benzidine dye injections are not always well tolerated. They may in fact cause a leukaemia due predominantly to toxicity to the myeloid cells (amphophils and basophils), and to a slighter extent to the lymphocytes. In such cases, monocytes may be even further increased in proportion and in absolute number. In one such instance there occurred a monocytosis so great that 75 per cent of the circulating leucocytes were monocytes.

It would seem probable from the study that monocytes and lymphocytes are not identical or closely related cell types, and furthermore, that if monocytes are produced in the lymphatic glands along with lymphocyte production, their rate of production is, however, insignificant. It is in fact more probable that the very low monocyte content of lymph is, like its erythrocyte content, due to the invasion of the lymph current by some of the blood elements.

72. Metamorphosis of the cranium in orang. T. Wingate Todd, Western Reserve University.

Measurements as applied to the cranium are unsatisfactory mainly because the points utilized bear no relation to some common and relatively little variable feature. Underlying all individual, sexual, racial differences there is a common plan of formation, growth and metamorphosis which bears a definite relationship to the common plan in biological groups more comprehensive than the species. In order to discern the fundamental and relatively invariable points in the cranium, growth and metamorphosis must be separated. With Miss Margaret Russell as co-worker, I have chosen the orang as a suitable animal upon which to work out the postnatal metamorphosis of the cranium, first, because it is a giant Anthropoid and, secondly, because the cranial capacity in the adult orang is often no greater than in the animal presenting a full milk dentition. Miss Russell and I have turned our attention first to the cranial base and we find that there are areas of practically no growth (between infancy and adult age) interspersed among areas where great growth takes place, notwithstanding the fact that the cranial capacity is the same. There is therefore considerable movement of one unit of the cranium upon another during this period of life. In spite of these mutual and harmonic changes in relative position of cranial units we find a very steady and definitely predictable position for the external auditory meati and also for certain other points such as the basion and the foramina ovalia. We expect to apply this method to the remainder of the cranium and to other Anthropoids and Man after we have solved the metamorphosis of a cranium comparatively simple because of its meager postnatal increase in cranial capacity.

73. The influence of feeding anterior lobe of hypophysis on growth and size of Amblystoma tigrinum. (Lantern.) E. Uhlenhuth (introduced by E. V. Cowdry), Rockefeller Institute for Medical Research, New York.

Up to the present, there are very few experiments which support the view that the feeding of the anterior lobe of hypophysis has any influence on growth and size of the animals. Growth curves and photographs are shown in lantern slides; they demonstrate that anterior lobe, when fed to metamorphosed salamanders of the species Amblystoma tigrinum, causes an increase in the rate of growth and size, the animals becoming larger than those fed on other substances. If the animals are given anterior lobe of hypophysis, they grow at a higher rate than those which are fed earthworms. Moreover, they attain a size far in excess of that reached by worm-fed or liver-fed animals, and surpass the largest known animal of the species. At present, the largest hypophysis-fed animal is 19 per cent in excess of the largest liver-fed animal, 25 per cent larger than the largest known normal animal, and 37 per cent larger than the largest worm-fed animal. Liver-feeding causes a rate of growth higher than that resulting from an earthworm diet and equal to that produced by anterior-lobe-feeding. But the liver-fed animals stop growing at a size at which anterior lobe-fed specimens of the same age continue to grow vigorously. Liver-fed animals may grow larger than worm-fed animals and may exceed the size of the largest known animal of the species by as much as 4.7 per cent, but they do not reach the size of hypophysis-fed animals.

74. The musculature of the stomach of the fetus and newborn. Elwyn H. Welch (introduced by R. E. Scammon), Department of Anatomy, University of Minnesota.

The arrangement of gastric musculature of older human fetuses and the newborn may be summarized as follows: 1. The external longitudinal layer is continuous with that of the esophagus and the duodenum. It completely invests the stomach but is very much thinned or even deficient at the mid-point of the dorsal and ventral surfaces. This coat is much heavier over the lesser curvature and in the regions of the cardia and of the pylorus. 2. The so-called middle coat of circular fibers is arranged in concentric rings from the duodenum to the cardia where they are slightly more numerous on the right and superior aspect. Over the fundus these fibers are incomplete and terminate by tucking-in to the circular fibers of the fundus which apparently have a distinctly separate origin. These latter fibers radiate from the center of the fundic dome and completely surround this portion of the stomach. 3. On the left side of the esophageal-cardiac junction, the region of the incisura cardiaca, the oblique or innermost layer bears the same relation as the circular fibers on the right side. This band is continuous above with the deep circular fibers of the esophagus and below with the circular fibers of the fundus. Its fibers course over the lateral wall in the direction of the pylorus ending by turning-in to and becoming a part of the overlying circular layer. At birth some of these fibers can be traced quite to the pylorus.

DEMONSTRATIONS

1. *Radiographs showing the blood supply of the pelvic viscera.* H. S. Burr, School of Medicine, Yale University.
2. *Microscopic preparations showing the transformed bladder muscle.* Eben J. Carey, Marquette School of Medicine.
3. *Flagellated thyroid cells in the dog-fish.* E. V. Cowdry, Rockefeller Institute.
4. *Grafts of chick embryo analages in the allantois.* Vera Danchakoff, Columbia University.
5. *Growth of the medullary tube grafted into allantois.* Anna Agassiz and Vera Danchakoff, Columbia University.
6. *Injection of the vascular system of the bone-marrow of the pigeon.* C. A. Doan (introduced by Florence R. Sabin), Johns Hopkins Medical School.
7. *Demonstration of preparations illustrating a strain of epithelial cells in pure culture.* Albert Fischer (introduced by E. V. Cowdry), Rockefeller Institute for Medical Research.
8. *The effect of the extirpation of the embryonic eye and ear on equilibration in Amblystoma punctatum. Demonstration of live specimens.* Walter F. Greene, (introduced by R. G. Harrison), Yale University.
9. *Injected pig embryos dissected and cleared to show the fate of the right dorsal aorta.* Chester H. Heuser, Department of Embryology, Carnegie Institution.
10. *Preliminary results of rotation of portions of the embryonic spinal cord about its long axis.* Davenport Hooker, University of Pittsburgh School of Medicine.
11. *Slides showing mitochondria and secretion granules and vacuoles in hyperactive human thyroids.* J. Albert Key, Harvard Medical School.
12. *Methylene-blue slides of nerves and nerve-terminations in the lung.* O. Larsell, University of Oregon Medical School.
13. *Pantographic reproductions of radiographs showing the position of abdominal viscera in healthy young adults.* Robt. O. Moody, University of California.
14. *Lantern slide demonstration of congenital abnormality of the hands and right limb.* H. S. Murphey, Iowa State College.
15. *Dorsal and ventral implantations of the limb bud.* J. S. Nicholas, University of Pittsburgh School of Medicine.
16. *Demonstration of preparations showing the reaction of the iron-containing proteins of the cells of the nucleus hypoglossus following axone injury.* F. M. Nicholson (introduced by R. R. Bensley), University of Chicago.
17. *Drawings, cleared specimens, and x-ray pictures illustrating the ossification of the laryngeal cartilages.* G. J. Noback, Medical College of Virginia.
18. *Graphs and curves illustrating the prenatal growth of the several parts of the respiratory system in man.* G. J. Noback, Medical College of Virginia.

The dissections and measurements were made on a series of specimens, both fresh and preserved, in the collection of the Institute of Anatomy, University of Minnesota. The graphs and curves were made by plotting the measurements against the total body length. The curves approximate straight lines in all but a few of the 46 measurements plotted.

19. Demonstration of sound transmission phenomena. A. G. Pohlman, St. Louis, University.

These demonstrations require the setting up of apparatus—time and place will be announced. 1. The manner in which the auricle overcomes the damping effect of the external auditory canal (air transmission). 2. The manner in which the stapedial foot-plate enhances a discharge of energy into the perilymph (solid to liquid transmission). 3. The diaphragm-rod theory of sound transmission (air to solid to liquid transmission). 4. The capacity of bone, tendon, elastic and muscle for sound transmission. 5. The piezo-electric reaction of the Rochelle salt transmitter to air, liquid, and solid transmitted sound. The writer expresses his obligation to Dr. F. B. Jewett of the Western Electric Research laboratory, N. Y., for the loan of this transmitter.

20. A preliminary report of a study of the human femur. J. A. Polczak and Edwin J. Simons (introduced by G. J. Noback), University of Minnesota.

A series of 248 human femurs have been measured and indexed to date. They consist of 48 fresh (paired) specimens and 200 from the osteological collection of the Institute of Anatomy. They are from peoples of various nationalities but the majority are of Scandinavian origin. The technic employed is the same as that employed by Parsons and by Holtby. The left femur is greater than the right in the following measurements and indices: Maximal Length, Oblique Length, Least Transverse Diameter, Bi-condylar Width, Diameter of the Head; Head Length Index, Platymeric Index, and Pilasteric Index. The above is true of the majority of the left femurs; however, when either femur is found to predominate in any one of its measurements or indices it generally predominates in all the others. The series is not yet completed and further work is being done on sexing.

21. Demonstration of developing blood-cells. Florence R. Sabin, Department of Anatomy, Johns Hopkins Medical School.

22. Field graphs and curves illustrating the growth of the human eyeball and optic nerve. R. E. Scammon and E. L. Armstrong, University of Minnesota.

23. Graphs and curves illustrating the transition from the fetal to the postnatal growth phases in man as shown by the projection of empirical formulae of fetal growth and by data on the growth increments of premature infants. R. E. Scammon, University of Minnesota.

24. Graphs and curves illustrating the prenatal growth of the human mandible. R. E. Scammon and S. J. Z. Ganz, University of Minnesota.

25. An orthoscopic apparatus for graphic reconstruction. R. E. Scammon, University of Minnesota.

26. Graphs and reconstructions illustrating the topography of the abdominal viscera in later embryonic and in fetal life. A. L. Cameron, University of Minnesota.

27. Graphs and curves of the postnatal growth of the human brain and spinal cord. R. E. Scammon and H. L. Dunn, University of Minnesota.

28. Graphs, curves and empirical formulae of surface area in man and animals. H. L. Dunn (introduced by R. E. Scammon), University of Minnesota.

29. Preparations to show the effects of inanition upon the mitochondria in the gastrointestinal mucosa and in the pancreas of the albino rat. Shirley P. Miller (introduced by C. M. Jackson), University of Minnesota.

30. Graphs illustrating the postnatal growth in weight of the various organs and parts of the guinea pig. A. N. Bessesen, Jr. and H. A. Carlson (introduced by C. M. Jackson), University of Minnesota.

31. Gross sections of an infant prepared and mounted by the glycerine-gelatine picture-frame method. Carl Caskey Speidel, University of Virginia; and Roy M. Hoover, New York Orthopaedic Hospital.

32. Demonstration of human skin showing dermal pigmentation only, and exhibiting the phenomenon of so-called blue skin. R. M. Strong, Loyola University School of Medicine.

33. Cleared embryos illustrating the order, time and rate of ossification in the rat skeleton. R. M. Strong, Loyola University School of Medicine.

34. Radiograph of a syndactylous hand, with an interpretative diagram. W. E. Sullivan, University of Wisconsin.

35. Dissection of a cod. To illustrate the function of articular discs. W. E. Sullivan, University of Wisconsin.

36. The effect of anterior lobe-feeding on the size of Ambystoma tigrinum. E. Uhlenhuth (introduced by E. V. Cowdry), Rockefeller Institute for Medical Research.

Live specimens of *Ambystoma tigrinum* are shown to demonstrate the effect of excessive feeding of the anterior lobe of the hypophysis on the size of adult salamanders. The hypophysis-fed salamanders exceed all the control animals in size.

37. Initial stages in the function of the suprarenal medulla in pig embryos. M. F. Weymann (introduced by C. H. Danforth), Department of Anatomy, Washington University School of Medicine.

Several investigators have maintained that the Henle reaction of cells in the suprarenal medulla is due to the presence of epinephrin in the cytoplasm. Test-tube experiments have tended to confirm this idea, since it is found that the precipitate formed when pure epinephrin is added to Müller's fluid is soluble in the same reagents as are the granules found within the cells showing the Henle reaction. These facts are believed to justify the assumption that the intensity of Henle's reaction furnishes an index of the degree of function in the suprarenal medulla. The specimens exhibited are suprarenal glands from pig embryos in different stages of development, fixed in Müller's fluid, hardened in alcohol, sectioned, and stained with neutral haematoxylin and eosin. This series of specimens indicates that: 1) the assumption of a secretory function by the medullary cells is a gradual process which is not complete until about the 142 mm. stage, after which the reaction appears to be fairly constant; 2) with the beginning of function the cells change in character from a more or less embryonic form with a large loose-meshed nucleus to a more specialized form with a smaller more deeply staining nucleus; 3) cells begin to show the reaction even while outside the cortex and at a considerable distance from their ultimate site; 4) all cells do not begin to function at the same time; 5) a few of them already show signs of function at the 45 mm. stage.

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WISLOCKI, GEORGE B., A.B., M.D., Associate in Anatomy, *Johns Hopkins Medical School, Baltimore, Md.*

WITHERSPOON, THOMAS CASEY, M.D., *Murray Hospital, Butte, Mont.*

WOODMAN, A. S., M.D., Assistant Professor of Histology and Embryology, *Boston University School of Medicine, Boston, Mass.*

WOOLLARD, HERBERT T., M.D., Demonstrator of Anatomy, *University College, Gower St., London, W. C. 1, England.*

WORCESTER, JOHN LOCKE, M.D., Professor of Anatomy, University of Washington, *5211–21st Avenue, N.E., Seattle, Wash.*

PROCEEDINGS OF THE AMERICAN SOCIETY OF ZOÖLOGISTS

The American Society of Zoölogists held its Nineteenth Annual meeting at the University of Toronto in conjunction with Section F of the American Association, and in association with other biological societies, December 28, 29, and 30, 1921.

Officers for the year were:

President: Charles A. Kofoid.
Vice-President: Aaron L. Treadwell.
Secretary-Treasurer: W. C. Allee.
Executive Secretary, Genetics Section: L. J. Cole.
Local Committee: A. G. Huntsman, *Chairman*, J. M. D. Olmsted, Lucy Clemens.
Executive Committee: H. V. Wilson, M. M. Metcalf, George Lefevre, C. M. Child, Gilman A. Drew.
Membership on the Council of the A. A. A. S.: C. C. Nutting and W. C. Allee.

Representatives of the Society in the Division of Biology and Agriculture of the National Research Council

	Term expires
F. R. Lillie	1923
William Patten	1924
G. H. Parker	1922

EDITORIAL BOARD OF THE JOURNAL OF MORPHOLOGY

Managing Editor (Term expires 1926) ..... C. E. McClung

Associate Editors

To serve until 1922	Gary N. Calkins J. S. Kingsley William Patten
To serve until 1923	E. G. Conklin M. F. Guyer W. M. Wheeler
To serve until 1924	C. A. Kofoid F. R. Lillie J. T. Patterson

BUSINESS MEETING

At the annual business meeting the appended report of the Treasurer and the Auditing Committee was accepted and ordered to be placed on file.

Expenditures in 1921

To The Wistar Institute for subscriptions:	
January 6	$68.00
February 25	4.50
June 6	1,971.50
July 4	11.00
August 14	48.00
October 25	28.00
November 3	.50
December 19	116.00
	$2,247.50
Expenses of office of Secretary-Treasurer:	
Printing nomination blanks	$13.50
To The Wistar Institute for programs, envelopes, etc	63.10
Telephone and telegrams	10.06
Stenography, typewriting, etc	57.00
Stationery	1.20
Petty cash	18.52
Fare of Secretary-Treasurer to Toronto	26.65
Miscellaneous:	
Expenses V. E. Shelford to Des Moines	60.50
Overpayment of dues	2.50
Foreign exchange	3.95
Correction (error of bank clerk)	10.00
	$266.98
	2,247.50
Total expenditures	$2,514.48

Receipts in 1921

Balance on hand at last report	$960.00
85 $5.00 dues	425.00
233 $7.00 dues	1,631.00
25 $11.50 dues	287.50
Irregular dues	73.34
Interest on savings	45.39
Money held or received in 1921	$3,422.57

Cash on hand, December 26, 1921:	
Savings account	$906.96
Checking account	1.13
	$908.09
Total expenditures in 1921	$2,514.48
Plus cash on hand	908.09
	$3,422.57

We have examined the accounts of the treasurer and found them correct.

A. S. Pearze,
Charles Zeleny,
Auditing committee.

Probable balance January 1, 1922

Balance, December 26, 1921	$908.09
Approximate interest on savings	12.50
Final dividend on trust fund liquidation	8.06
	$928.65
Bills payable January 1:	
The Wistar Institute for subscriptions	80.00
Expenses of Secretary's office	40.00
Probable balance January 1, 1922	$808.65
Balance, January 1, 1921	889.30
Probable loss for the year	$81 71

In addition, there are 31 members or ex-members in arrears for a total of 43 years, aggregating dues amounting to $293.50.

Election of members

The appended list of zoölogists were duly nominated for membership in the Society, as having shown evidence of continued contribution to zoölogical research, and were elected.

Adolph, Edward Frederick, A.B., Ph.D. (Harvard), Instructor in General Physiology, University of Pittsburgh, *Biology Hall, University of Pittsburgh, Pittsburgh, Pa.*

Alexander, Charles Paul, B.S., Ph.D. (Cornell), Systematic Entomologist for the State Natural History Survey of Illinois, *Natural History Bldg., 316 A, Urbana, Illinois.*

Allen, William Ray, A.B., A.M., Ph.D. (Indiana), Associate Professor of Zoölogy, University of Akron, *University of Akron, Akron, Ohio.*

Baker, Horace Barrington, B.S., Ph.D. (Michigan), Instructor of Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*

Blanchard, Frank N., A.B. (Tufts), Ph.D. (Michigan), Instructor in Zoölogy, University of Michigan, *University of Michigan, Ann Arbor, Mich.*

Bodine, Joseph Hall, A.B., Ph.D. (Pennsylvania), Instructor in Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*

Bowen, Robert Hall, A.B. (Colby), A.M., Ph.D. (Columbia), Instructor in Zoölogy, Columbia University, *Department of Zoölogy, Columbia University, New York City.*

Cameron, Alfred Ernest, M.A., B.Sc. (Aberdeen), M.Sc. (Manchester), D.Sc. (Aberdeen), Professor of Zoölogy, University of Saskatchewan, *616, Lansdowne Avenue, Saskatoon, Sask.*

Cole, William H(arder), A.B., A.M., Ph.D. (Harvard), Professor of Biology, Lake Forest College, *Lake Forest, Illinois.*

Collett, Mary Elizabeth, A.B. (Wellesley), A.M., Ph.D. (Pennsylvania), Instructor in Physiology, Dept. of Medicine, University of Buffalo, *University of Buffalo (Medical), 24 High Street, Buffalo, N. Y.*

Cowles, Rheinart P., A.B. (Stanford), Ph.D. (Hopkins), Associate Professor of Zoölogy, *Johns Hopkins University, Baltimore, Md.*

Dawson, Alden Benjamin, A.B. (Acadia), Ph.D. (Harvard), Assistant Professor Microscopical Anatomy, Loyola University School of Medicine, *706 S. Lincoln St., Chicago, Illinois.*

Ellinger, Tage U.H., M.S. (Copenhagen), Statsstipendiat (Danish Government), Fellow of American-Scandanavian Foundation, *1105 Busey Ave., Urbana, Illinois.*

Hopkins, Hoyt Stilson, A.B., A.M. (Oberlin), Ph.D. (Hopkins), Assistant Professor of Physiology, *Baylor Medical College, Dallas, Texas.*

Hubbs, Carl L., A.B., A.M. (Stanford), Curator and Instructor, *Museum of Zoölogy, University of Michigan, Ann Arbor, Michigan.*

Hunter, George William, A.B., A.M. (Williams), Ph.D. (New York University), Professor of Biology, Knox College, *Galesburg, Illinois.*

Lancefield, Donald E., A.B. (Reed), M.A., Ph.D. (Columbia), Assistant Professor of Zoölogy, *University of Oregon, Eugene, Oregon.*

Macarthur, James Wood, A.B. (Oberlin), M.A. (Wabash), Ph.D. (Chicago), Lecturer in Genetics and Experimental Biology, University of Toronto, *Department of Biology, University of Toronto, Toronto, Canada.*

McEwen, Robert Stanley, A.B., A.M. (Western Reserve), Ph.D. (Columbia), Assistant Professor of Zoölogy, Oberlin College, *Spear Laboratory, Oberlin College, Oberlin, Ohio.*

Okkelberg, Peter, A.B., A.M. (Minnesota), Ph.D. (Michigan), Assistant Professor of Zoölogy, University of Michigan, *1116 Ferdon Road, Ann Arbor, Mich.*

Parmenter, Charles Leroy, A.B., M.A. (Southern California), Ph.D. (Pennsylvania), Instructor of Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*

Pinney, Mary Edith, A.B., A.M. (Kansas State), Ph.D. (Bryn Mawr), Professor of Biology, Lake Erie College, *Painesville, Ohio.*

Reagan, Franklin Pearse, A.B. (Indiana), Ph.D. (Princeton), Assistant Professor of Zoölogy, University of California, Chairman of the Department, 1921–2, *219 East Hall, University of California, Berkeley, California.*

RHODES, ROBERT C(LINTON), A.B. (Henderson Brown), A.B., A.M., (Vanderbilt), Ph.D. (California), Professor of Biology, *Emory University, Ga.*

SCHRADER, FRANZ, B.S., Ph.D. (Columbia), Associate in Biology, *Bryn Mawr College, Bryn Mawr, Pa.*

STEINER, GOTTHOLD, Ph.D. (Berne), Privatdocent in Zoölogy, University of Berne, Seesel Research Fellow, Yale University, 1921–22, *Osborn Zoölogical Laboratory, Yale University, New Haven, Conn.*

STUNKARD, HORACE W., B.S. (Coe), A.M., Ph.D. (Illinois), Assistant Professor of Zoölogy, *New York University, University Heights, New York City.*

WEED, LEWIS HILL, A.B., A.M. (Yale), M.D. (Hopkins), Professor of Anatomy, *Johns Hopkins Medical School, Baltimore, Md.*

WOODWARD, ALVALYN E., A.B., M.S. (Rochester), Ph.D. (Michigan), Demonstrator in Biology, *Amherst College, Amherst, Mass.*

YOUNG, BENJAMIN P., B.S. (Kansas), Ph.D. (Cornell), Assistant Professor of Zoölogy, Cornell University, *209 Eddy St., Ithaca, N. Y.*

YUASA, HACHIRO, B.S. (K.S.A.C.), M.S., Ph.D. (Illinois), Research Entomologist, Illinois State Natural History Survey, *Natural History Bldg., University of Illinois, Urbana, Ill.*

WILLIAM BATESON, Director of the John Innis Horticultural Institution, Morton Park, Surrey, England, and joint guest of The American Society of Zoölogists and The American Association for the Advancement of Science, at Toronto, was elected an honorary fellow of the Society.

The Secretary reported that five members were two years or more in arrears for dues, and these were accordingly no longer members of the Society, according to Art. II, Sec. 3, of the Constitution. Of six members dropped in 1920, three had been reinstated on payment of dues to date. The total membership at present is 357.

Attention of the Society was called to the agreement with the Wistar Institute, which is reprinted below:

The Wistar Journals

It has recently become apparent that some members do not understand the nature of the agreement between the American Society of Zoologists and The Wistar Institute regarding the Wistar journals. For this reason a statement written by Caswell Grave early in 1916, is re-printed here. Professor Grave was Secretary-Treasurer for the Society at the time and was active in the negotiations between the Society and The Wistar Institute which led to the present arrangement.

WHY THE PROPOSITION WAS MADE AND ACCEPTED

From The Wistar Institute standpoint the proposition was made for these reasons:—

a) To place the Journals in the hands of those who are most active in the promotion of Zoölogical research.

b) To unite in a "Triple Alliance" the two Societies and an endowed research institute for organized effort in all that pertains to the progress of Zoological science.

A special fund has been raised to accomplish these purposes with the least possible tax upon the individual members of the Society, and to aid in the prompt publication and extensive distribution of the rapidly increasing number of papers accepted for publication.

From the standpoint of the Society it seemed a duty of the Society to come to the aid of American Zoölogical Journals at this time and assist in placing them upon a basis such that they may serve the purposes for which they were established, and provide an adequate means for publishing and distributing the work of American biologists.

A proposition, whereby members of the Society might for $6.50 receive Journals representing a value of $42.00, also seemed attractive even to a Zoologist with small salary, and one not to be lightly turned down.

THE AGREEMENT

Between the American Society of Zoölogists and The Wistar Institute there is no formal agreement in this matter, but, in making the proposition, The Wistar Institute stated in its printed circular and in the copy presented at the meeting that this offer is to members only—and that the end aimed at by the Institute will be defeated if the Journals intended only for the reading tables of members are allowed to reach University or College libraries, thus causing the loss of subscriptions made by Institutions at the regular rate; and, in accepting the proposition, the Society morally bound its members not to allow journals, secured by them at the low Society Rate, to be substituted for journals subscribed for by Institutions at *regular rates*.

It is understood, however, that previous subscriptions by members to these journals at regular rates need not be kept up.

In reply to an inquiry whether the Journal proposition could be made to the Society provided 50% or 75% of the membership were guaranteed by the Society to accept, the director of the Wistar Institute stated that the low Society rate on the Journals could be made only in case a sum is paid by the Society equivalent to $6.50 for each regular member and provided the name of every such member is added to the mailing lists of the journals.

There have been no changes in the agreement with The Wistar Institute since that time, and so far as the present Secretary-Treasurer can learn, the arrangement has worked well. It is certainly true that members of The American Society of Zoölogists get more journals for the money invested than any other Society which supports a publication program, excepting only the Anatomists, who have a similar agreement with The Wistar Institute. It would cost approximately half our annual dues to print and circulate the Announcement, Abstracts, Proceedings and Membership List which under the present arrangement cost about twenty cents per member per year.

The Secretary was instructed to prepare a formal notification blank to be used in informing new members of their election,

of the privileges of members, and their responsibilities with regard to the Society's journal arrangement.

Proposed amendments made in accordance with Article VI of the Constitution, allowing for the separation of the office of Secretary-Treasurer, were adopted. The By-Laws are also amended to the same end. The Constitution and By-Laws, as amended, will be found on pages 134–7.

Report of the Nominating Committee

The Nominating Committee (see Art. III, Sec. 6), composed of M. F. Guyer S. J. Holmes and J. H. Gerould, report the following nominations:

President—H. H. Wilder.
Vice-President—B. M. Allen.
Secretary—W. C. Allee.
Treasurer—D. H. Tennent.
Member Executive Committee—C. A. Kofoid.
Member National Research Council—H. S. Jennings.
Three Associate Editors of the Journal of Morphology—L. L. Woodruff, G. A. Drew and H. V. Neal.
Membership in Council, A. A. A. S.—Charles Zeleny and H. E. Crampton.

Nominations from the floor were called for; none were presented and the proposed ticket was elected.

In accordance with the resolution adopted at St. Louis, the Executive Committee announced the appointment of A. L. Treadwell and A. A. Schaeffer as members of the Advisory Board to serve four years.

Committee reports

Since the last meeting, President Kofoid appointed S. I. Kornhauser as the representative of the Society in a cooperative movement with the Society of American Bacteriologists to attempt to standardize American dyes for biological purposes. Professor Kornhauser reported that some information had been collected by means of questionaires at Woods Hole and elsewhere, and requested members to furnish information concerning their experience with American dyes in comparison with standard stains formerly imported. Doctor Kornhauser stated that he was ready to answer inquiries at any time regarding available

American dyes. The Society voted $25.00 from its funds to defray the expenses incurred in this investigation.

Conference concerning the relations of genetics to the biological societies

Early in 1921 L. J. Cole and R. A. Emerson sent out a circular letter to the officers and members of the Executive Committees of the societies interested calling attention to a movement among the younger geneticists of the country towards the formation of a separate society and suggesting that representatives of the societies now dealing with genetics meet in conference to discuss possible solutions which would give the geneticists the unity they need without causing the formation of another special society.

The conference was held at the University Club in Chicago, Friday, June 3, 1921, and was attended by Allen (President), Cowles, Crocker, L. R. Jones and Trelease of the Botanists; Allee, Cole, Detlefsen, Guyer and F. R. Lillie of the Zoologists and Davis (President) of the Naturalists.

The conference adopted the following recommendations by general consent without a dissenting voice:

1. That the Division of Biology and Agriculture of the National Research Council call a meeting of officers or representatives of biological societies at Toronto to discuss the formation of a federation of biological societies.

2. That sections be formed in the Botanical Society of America and the American Society of Zoologists to have charge of the genetics programs of the societies beginning with the Toronto meeting, under the joint direction of an executive secretary from each society and a single chairman who will be chosen alternately from each society.

Further details in the development of this plan were referred to the secretaries of the two societies.

As a result of the first recommendation, on invitation of the Division of Biology and Agriculture, National Research Council, a conference of the presidents and secretaries of a number of biological organizations met at Toronto with representatives of the Division, on the afternoon preceding the meetings. The resolutions adopted by this conference were presented to the Society by F. R. Lillie, and approved by the Society. The resolutions follow:

Resolved, 1. That it is the sense of this conference that an intersociety conference should be called to study and report upon the feasibility of federation of the biological societies and to develop plans for the said federation.

2. That for the purpose of effecting such an organization, each society, and Sections F and G of the American Association for the Advancement of Science, be requested to designate its President and Secretary as members of an inter-

society council which shall be authorized, 1) to deal with all matters of common interest, such as pooling of programs, that are consistent with the existing regulations of the constituent societies, and, 2) to draw up proposals for a constitution and by-laws of a federation of the societies in question, and to present them for action at the next annual meeting.

Although no formal action was taken, it was understood that the conference raised by the adhering societies should be empowered to invite other organizations to join it later.

In accordance with the second recommendation of the Chicago Conference, the Genetics Sections of the two societies met together in Lecture Theatre 60 A of the Biological Building beginning on Wednesday morning, December 28. The sections were called to order by Dr. R. A. Emerson, Executive Secretary for the Botanists. He at once appointed a committee of three to nominate a chairman for the Toronto meeting. A. F. Blakeslee was nominated and duly elected, taking the chair at once.

In the afternoon, upon motion, the chair appointed L. J. Cole, R. A. Emerson, H. S. Jennings, A. F. Shull, and G. N. Collins a committee to formulate a plan of organization for the Genetics Sections to report on Friday morning.

In the Zoölogists business meeting Friday morning the following action was taken authorizing the formation of a Section in Genetics:

Moved, That authorization be given for the formation of a Genetics Section of the American Society of Zoölogists to coöperate with the similar section established in the Botanical Society of America.

It shall be understood that any member of the American Society of Zoölogists may become a member of the Genetics Section by indication of his desire to that effect.

Any member of the Society submitting a paper on genetics has the right to have it included in the program of the Genetics Section.

The Genetics Section may designate one of its members as a consulting member of the Executive Committee of the American Society of Zoölogists.

The Genetics Sections reconvened following the Business Meeting of the American Society of Zoölogists. The committee on organization submitted the following report:

Articles of organization

Resolved: That the Genetics Sections of the American Society of Zoölogists and the Botanical Society of America organize for the purpose of securing a closer coördination of genetic interests.

The membership shall consist of those members of the two Societies who shall indicate their desire to be affiliated with the Genetics Sections.

The following officers shall be elected at each annual meeting and shall take office at the close of the meeting.

1. A Chairman, to be chosen alternately from the Zoölogical Section and from the Botanical Section.

2. A Secretary, who may be chosen from either Section.

3. A Society Representative, who shall be chosen from the Section other than from that from which the Secretary is chosen.

These three officers shall constitute the Executive Committee of the Genetics Sections.

In addition to his usual duties, the Secretary shall, in consultation with the other members of the Executive Committee and with the Secretaries of the Societies, arrange the program of the meetings.

The Secretary and the Society Representative shall act as the representatives of the Genetics Sections to their respective Societies.

At the annual meeting the Chairman shall, in advance of the business meeting, appoint a Nominating Committee of three to nominate officers for the following year.

These articles were adopted as proposed.

Upon motion, the Chairman appointed the following a committee to nominate officers for the coming year as provided in the Articles of Organization: R. A. Emerson, G. H. Shull, Charles Zeleny.

This committee later announced as nominees:

For Chairman: H. S. Jennings.
For Secretary: L. J. Cole.
For Society Representative: B. M. Davis.

These were duly elected.

The Secretary reported on the condition of the American Genetics Association and the needs of the *Journal of Heredity*, and stated that efforts would be made to hold a conference between the Executive Committee of the Genetics Sections and the Council of the American Genetics Association to see what steps can be taken for their mutual benefit.

This transcript of the proceedings of the Genetics Sections, together with the report of the papers presented which will be

found elsewhere in these proceedings, was furnished by the Secretary of the Sections, Dr. L. J. Cole.

The following resolution, growing out of the conference concerning a similar organization of parasitologists within the Society was presented and approved:

Resolved, That the Parasitologists assembled at Toronto request the officers representing the Society in the proposed conference on federation of biological societies, and, further, instruct their special representative, should the conference admit one, to urgently request, that the conference arrange for membership in the Section of Parasitology of persons who do not meet the present requirements for membership in the Society of Zoölogists.

The parasitologists appointed C. A. Kofoid as their representative, with B. H. Ransom as alternate.

In accordance with action taken at the last meeting, President Kofoid had appointed V. E. Shelford a delegate from the American Society of Zoölogists to the National Conference on Parks held in Des Moines, Iowa, January 10, 11 and 12, 1921. Dr. Shelford submitted the following report:

While a small number of scientific societies were represented, the conference was well attended, especially by those interested in natural parks for recreation purposes. Their aim is to secure more parks and protect existing ones. Very few of the existing parks and preserves are free from liability to extensive modification through recreation activities, scientific forestry, fires, or exploitation. Even the National Parks must be watched and defended. There are now only a few areas aside from the National Parks which have been set aside with the intention that they should be left in a natural state. Most areas have been and probably will continue to be set aside primarily as recreation parks, or as forest preserves. The main business of those interested in areas to be held in an original state, must of necessity be to get areas set aside within these forest preserves and parks.

The following was made evident by the conference:

1. That the forces interested in the establishment of natural parks and forest preserves for recreation purposes—to make "better citizens through contact with nature" are well organized, and are probably the strongest force operating to secure more parks and protect existing ones.

2. Science has left them quite ignorant of its needs for natural areas and of the practical significance of scientific results which may accrue from study of natural areas. They welcome the idea of biological study "as a further argument for natural tracts."

3. They are, however, without constructive plans of management of the smaller tracts which will insure them against destruction from over use as recreation

parks. Such plans of management must be based on knowledge of plant and animal ecology which they do not possess.

4. They are engaged in drafting legislation and in advising legislators without the counsel of those interested in preserves for research purposes.

5. It is incumbent upon scientific societies, museums, and Universities to organize and to provide funds which will serve the following purposes: (a) to place information as to the scientific uses, and scientific management of natural areas, into the hands of those individuals and organization working for the preservation of natural conditions (b) to make possible the representation of scientific needs before legislative bodies and officials (c) to provide for furthering the wise selection of new areas, and (d) to make existing areas accessible to scientists by the publication of lists and guide books.

Communications from other organizations

Eugene C. Bingham, of Lafayette College, Chairman of the Metric Committee of the American Chemical Society, urged all Zoölogists to assist in the establishment of metric units for scientific materials, especially in the matter of ordering chemicals by metric units.

Robert M. Yerkes, of the Research Information Service, spoke briefly concerning the purpose and possibilities of that Service. An abstract of his account is published in the Proceedings.

From the Ecological Society of America, December 28, 1921:

To the American Society of Zoölogists:

For several years past the Ecological Society through the present committee has been locating and briefly describing areas in which the original flora and fauna are little disturbed and which are accordingly suitable for scientific research. Some knowledge regarding about 1000 areas in the United States and Canada is on hand, but the degree of modification from the original state must be estimated for each area. It has been proposed to use letters to designate the condition of the flora and figures to designate the condition of the fauna. It has been suggested that there is only one area in the United States which is really in its original condition. This is due to the general destruction of large game.

It is regarded as highly desirable to press the work to completion and publish it at an early date. The funds available from the Ecological Society and from the National Research Council cannot provide for circulating the necessary questionaires at an early date. The Ecological Society accordingly authorized the committee to request the American Society of Zoölogists to provide for the work of classifying areas from the standpoint of animals, funds up to $25.00.

The Society of Zoölogists will be given full credit for this work if the request is granted.

Respectfully submitted by

V. E. Shelford,
Senior Chairman.

The Society voted that $25.00 from its funds be placed to the credit of V. E. Shelford for this work, as requested.

General resolutions

The following resolution was adopted and ordered sent to the appropriate officials:

The American Society of Zoölogists, understanding that there is a temporary suspension of certain scientific publications of the U. S. Government, including the Journal of Agricultural Research, the Experiment Station Record, and the Monthly Weather Reports, desires to put on record its very high appreciation of these journals and of their great national and international importance in the field of natural science and would respectfully urge their resumption at as early a date as possible.

The following resolution was adopted:

Resolved, That the Secretary express to President the of the University of Toronto and the local committee on arrangements the high appreciation of the American Society of Zoölogists for the splendid facilities afforded this meeting and for the cordial hospitality shown the members attending.

PROGRAM

Wednesday, December 28

10:00 A.M. Section A, Lecture Theatre 14, Biological Building. Papers dealing with Embryology, Cytology, and Comparative Anatomy; seven papers presented in full, five of which were discussed. Attendance, 75.

10:00 A.M. Section B, Lecture Theatre 60A, Biological Building. Papers on Evolution and Genetics from the Botanical Society of America. Attendance, about 75.

2:00 P.M. Section B continued with papers from the American Society of Zoölogists. Attendance, 125 to 150.

5:00 P.M. Meeting Executive Committee.

8:30 P.M. Public Address before the entire American Association in Convocation Hall by Professor William Bateson, who had been brought over from England on the initiative of the American Society of Zoölogists in coöperation with the American Association. President Kofoid introduced the speaker of the evening.

10:00 P.M. Biological Smoker, Hart House. The smoker was arranged by the American Society of Zoölogists. All interested persons were invited to attend. Smokes and cold refreshments were furnished by the Local Committee. Hundreds present.

THURSDAY, DECEMBER 29

9:40 A.M. Biological Building, Lecture Theatre 14; Joint meeting with the Ecological Society of America for the presentation and discussion of papers on Ecology and Zoogeography. Eleven papers were presented in full, seven of which were followed by discussion. President S. A. Forbes, of the Ecologists, presided during most of this session. Attendance, 90.

2:00 P.M. Section A, Parasitology, Lecture Theatre 14. President Kofoid, presiding. Herbert Rand, Secretary. Eight papers were presented in full. By vote of the Society, B. H. Ransom was given as much time as he needed to show two reels of films for his paper on "A new venture in the field of practical parasitology." At the close of the session, the members present spent about 45 minutes in discussing the problem of organization. The resolution adopted is recorded in the proceedings of the business meeting. Attendance, 45.

Section B. General and Comparative Physiology. Lecture Theatre 60 A. Vice-President Treadwell presiding. Nine papers presented in full, four of which were followed by discussion. The section voted to receive papers by E. Horne Craigie and W. H. Longley which had arrived too late for inclusion in the general program. Attendance, 24.

5:00 P.M. Meeting Executive Committee.

FRIDAY, DECEMBER 30

9:30 A.M. Business Session, Lecture Theatre 14. Maximum attendance, about 75. In addition to the business, papers were presented at this session by Robert M. Yerkes. (No. J. 1) and by E. E. Prince, Dominion Commissioner of Fisheries (No. J. 2). The latter was followed by discussion.

2:15 P.M. Medical Building, Lecture Theatre 19. Zoölogists' Symposium on *Orthogenesis*. This was participated in by Lawrence Henderson, C. B. Lipman, M. F. Guyer, H. F. Osborn, J. C. Merriam, and William Bateson with some discussion from the chair and from the floor. Attendance, over 220.

7:45 P.M Zoölogists' Dinner in the dining Hall at Knox College, Address, "The Outlook in Genetics" (illustrated), by William Bateson. Attendance, 112.

In coöperation with Botanical Society of America, the American Society of Naturalists, the Ecological Society of America and other interested societies, the Zoölogists participated in a bulletin service whereby members could keep track of the progress of the programs in related societies. The service was arranged by and under the direction of J. R. Schramm, Secretary of the Botanical Society.

LIST OF TITLES

The following titles, contributed for the program, have been grouped and arranged in accordance with rules accepted by the Society.

Papers marked with an asterisk were read by title.

A. EVOLUTION AND GENETICS

Papers from the Botanical Society of America

1. The synthesis of full coloration in Phlox. (4 min.) James P. Kelly.
2. The inheritance of shape in the fruit of the summer squash. (Lantern; 5 min.) Edmund W. Sinnott.
3. Correlated inheritance in wheat of winter-spring habit of growth and rust resistance. (Charts; 10 min.) Olaf S. Aamodt.
4. The linkage relations of the factors for shrunken endosperm *Sh sh*, waxy endosperm *Wx wx* and the aleurone color factor *C c* and *I i* in maize. (Lantern; 15 min.) C. B. Hutchison.
5. Crossing over in F1 maize-teosinte hybrids. (Lantern, 5 min.) L. F. Randolph.
6. Mexican wild relatives of maize. (Lantern, 20 min.) G. N. Collins.
7. Studies of somatic mutations in variegated maize pericarp: I. Relative frequency of dominant somatic mutations in homozygous and in heterozygous variegated pericarp. (Lantern; 15 min.) R. A. Emerson. II. Frequency of mutation in relation to development. (Lantern, 10 min.) W. H. Eyster and E. G. Anderson. III. An interpretation. (Lantern, 10 min.) E. G. Anderson and M. Demerec.
8. Studies on the pollen tubes and abortive ovules of the Globe mutant of Datura. (10 min.) J. T. Buchholz and A. F. Blakeslee.
9. The effect of a single gene as compared with that of a single chromosome upon the gross structure of Datura. (Lantern; 10 min.) E. W. Sinnott and A. F. Blakeslee.
10. Three new mutations in Oenothera Lamarckianna. (Lantern; 12 min.) George H. Shull.
11. Variation and mutation in Pestalozzia Guepini Desm. (Lantern; 8 min.) Carl D. LaRue.
12. Inheritance of flower types and fertility in the strawberry. (10 min.) W. D. Valleau.
13. The accumulative effect upon a pure line of wheat, of ten generations of growth under diverse conditions of soil fertility. (10 min.) C. H. Myers.
14. The immediate effect of foreign pollen upon the kernel development of maize. (15 min.) T. A. Kisselbach.

A′. EVOLUTION AND GENETICS

Papers from the American Society of Zoologists

1. Relative nuclear volume and the life cycle of Hydatina senta. (Lantern.) A. Franklin Shull, University of Michigan.
2. The action of alcohol upon germinal material. (Lantern.) E. Carlton MacDowell, Cold Spring Harbor.

3. Parallelism in Ascidians, with a new conception of organic structure. A. G. Huntsman, University of Toronto.
*4. Effect of temperature upon the development of the eye of *variable*, a mutant from Drosophila hydei. Roscoe R. Hyde. The Johns Hopkins University.
5. Heritable effects of chemically differing media on the fission rate of Paramecium caudatum. A. R. Middleton, University of Louisville.
6. Heredity of resistance to tuberculosis in guinea-pigs. (Lantern.) Sewall Wright and Paul A. Lewis, Bureau of Animal Industry and Phipps Institute.
*7. Data on the inheritance of spurs in the female fowl. H. D. Goodale, Massachusetts Agricultural Experiment Station.
8. Heredity of build. (Lantern.) Charles B. Davenport, Cold Spring Harbor.
9. Effective reverse selection in bar eye of Drosophila due to the appearance of mutations. (Lantern.) Charles Zeleny, University of Illinois.
10. Genetic mosaics and ontogenetic abnormalities in the parasitic wasp, Hadrobracon. (Charts.) P. W. Whiting, University of Iowa.
11. Olive, a mutation in Colias philodice. John H. Gerould, Darmouth College.
12. Incomplete synapsis of chromosomes and its possible relation to linkage variations. (Lantern.) C. W. Metz, Carnegie Institution of Washington.
13. A cross in guinea-pigs best explained by assuming 75 per cent crossing over. (Lantern.) Herman L. Ibsen, Kansas State Agricultural College.
14. A linkage diagram of nine factors for color patterns in Apotettix eurycephalus Hancock. Robert K. Nabours, Kansas Agricultural Experiment Station.
15. Genetic analysis of low crossover stock, produced by selection. J. A. Detlefsen and L. S. Clemente, University of Illinois.
16. Ten years with the self-fertilized line of Lymnaea columella Say. Harold Sellers Colton, University of Pennsylvania.
17. Results of eight years of inbreeding of Rhode Island Red fowls. (Lantern.) L. J. Cole and J. G. Halpin, University of Wisconsin.
*18. Inheritance of color in the domestic turkey (continued). W. R. B. Robertson, University of Kansas.
*19. Orthogenesis of non-homochromic pigmentation in Chromodorids. W. J. Crozier, Rutgers College.
*20. Breeding experiments with the viviparous teleosts, Xiphophorus helleri and Platypoecilus maculatus. (Günth.) A. W. Bellamy, University of Chicago.
21. The elimination of the sex-chromosome by X-rays: A modification of the germ plasm produced by an external agent. James W. Mavor, Union College.
*22. Hybrid vigor, hybrid weakness and the chromosome mechanism of heredity. An experimental analysis of the physiology of heredity in the reciprocal crosses between two closely associated species of sea-urchins, Strongylocentrotus purpuratus and S. franciscanus. H. H. Newman, University of Chicago.
*23. Changes in egg production at the Massachusetts Agricultural Experiment Station. H. D. Goodale, Massachusetts Agricultural Experiment Station.

24. Variations in the number of vertebrae and other segmental characters of fishes correlated with the temperature of the water during development. Carl L. Hubbs, University of Michigan. (Introduced by L. V. Heilbrunn.)
25. (Received by vote of the section.) A lethal gene which changes the order of the loci in the chromosome map. H. J. Muller, University of Texas.

B. EMBRYOLOGY

1. Cell behavior in tissue culture. (Lantern.) H. B. Goodrich, Wesleyan University.
*2. Experiments with Necturus and axolotl thyroids. W. W. Swingle, Yale University.
*3. Chorinonic fusion and augmented twinning in the human tube. Leslie B. Arey, Northwestern University Medical School.
4. The influence of thyroid gland feeding upon tadpoles from which the thyroid gland and the buccal anlage of the hypophysis have been removed. Bennet M. Allen, University of Kansas.

C. CYTOLOGY

1. A determination of the degree of constancy in the nuclei of certain organs in Hydatina senta. H. J. Van Cleave, University of Illinois.
2. Further studies in the cytology of Asolabis maritima Bon. (Lantern.) S. I. Kornhauser, Denison University.
*3. The occurrence of telosynapsis in the male germ cells of Leptocoris trivittatus Say (Hemiptera). Harry B. Yocum, University of Oregon.
*4. Studies on the cells of sheep with special reference to spermatogenesis, oogenesis and sex-determination. (Lantern.) J. E. Wodsedalek, University of Idaho.
5. The structure and division of Trichomonas augusta, Alexeieff. D. H. Wenrich, University of Pennsylvania.
6. Multinucleated germ cells in the Columbian ground squirrel. (Lantern.) J. E. Wodsedalek, University of Idaho.
*7. Seasonal changes in the testis of Gambusia affinis, the top-minnow. S. W. Geiser, The Johns Hopkins University. (Introduced by S. O. Mast.)
*8. Changes in the vaginal epithelium of the guinea pig during the oestrous cycle. R. M. Selle, University of California. (Introduced by J. A. Long.)
*9. (By vote of the Section, the following papers were received, ordered placed on the program and abstracts were ordered printed.)
The spermatogenesis of man, Theophilus S. Painter, University of Texas.
*10. The Spermatogenesis of the opossum. Theophilus S. Painter.

D. COMPARATIVE ANATOMY

*1. Metamorphic changes in the digestive system in Rana pipiens and Amblystoma tigrinum. Albert Kuntz, St. Louis University School of Medicine.
2. The skull of Syngnathus fuscus. James E. Kindred, Western Reserve University.

*3. The thyroid glands of perennibranchiate Amphibians. W. W. Swingle, Yale University.
*4. On the muscular system of Ornithodorus moubata (Murray). E. Melville Du Porte, Macdonald College, McGill University.
5. On the structure and development of a fat body or gland in the rat. J. A. Long, University of California.
*6. Relation of growth to metamorphosis in the lungless salamander, Eurycea bislineata. Inez Whipple Wilder, Smith College.
*7. Degeneration in the pelvis of the female pocket gopher, Geomya bursarius. Frederick L. Hisaw, Kansas State Agricultural College. (Introduced by J. E. Ackert.)

E. ECOLOGY AND ZOOGEOGRAPHY

1. Chemical composition of some fresh-water organisms. C. Juday, University of Wisconsin and Wisconsin Geological and Natural History Survey.
2. Some adaptations of mayfly nymphs to swift streams. C. S. Dodds and F. L. Hisaw, West Virginia University.
3. Some physical factors related to the distribution of littoral invertebrates. W. C. Allee, University of Chicago.
4. Ecology of parasites of lake fishes. A. S. Pearse, University of Wisconsin.
5. The eggs of the frogs, tree frogs and toads of Okefinokee Swamp, Georgia. A. H. Wright, Cornell University.
6. Further studies on the circulation of water in the Bay of Fundy and the Gulf of Maine. James W. Mavor, Union College.
7. The effect of temperature in limiting the geographical range of invertebrates of the Woods Hole littoral. W. C. Allee, University of Chicago.
8. Hydrogen ion concentration of Chespeake bay water. R. P. Cowles and A. M. Schwitalla, S.J., The Johns Hopkins University. (Introduced by S. O. Mast.)
*9. Canuella canadensis and other Canadian copepods. A. Willey, McGill University. (Introduced by A. G. Huntsman.)
10. Notes on the Crocodilia of British Guiana. A. M. Reese, University of West Virginia.
11. A noteworthy adaptive modification of the webs of a Siamese Agriopid spider. H. E. Crampton.
12. On the distribution and ecology of the species of *Partula* inhabiting the Mariana Islands of the Western Pacific Ocean. H. E. Crampton, Barnard College.

F. GENERAL ZOÖLOGY

1. On the rate of growth of Teredo and Xylotrya. (Lantern.) Thurlow C. Nelson, Rutgers College and the New Jersey State Board of Shellfisheries.
*2. Observations on sex in the top-minnow, Gambusia affinis. S. W. Geiser, The Johns Hopkins University. (Introduced by S. O. Mast.)

G. PROTOZOOLOGY

*1. Trophic and reproductive chromatin in the ciliate infusoria compared with similar conditions in other protozoa. M. M. Metcalf.
*2. Some effects of conjugation in the life history of Spathidium spathula. Lorande Loss Woodruff and Hope Spencer, Yale University.

H. PARASITOLOGY

(All workers in America who have recently published work in parasitology are invited to participate in the parasitology program at Toronto on the same terms as members of the Society.)

*1. The parasitic Protozoa of Blatta orientalis and their value as the material for use in class of parasitic Protozoa. R. Kudo, University of Illinois.
2. A preliminary report of the activities of infective hookworm larvae in the soil. William W. Cort and Donald L. Augustine, The Johns Hopkins University.
*3. Notes on North American blood flukes. G. A. MacCallum, Baltimore.
*4. A study of Diphyllobothrium ova. Meyer Wigdor.
5. A new genus of Trematodes from the white-bass. H. J. Van Cleave, University of Illinois.
*6. Apparent racial immunity to certain Nematode infections. Benjamin Schwartz and Marcos A. Tubangui, University of the Philippines.
7. Intestinal protozoan infections as an index of personal hygiene and institutional sanitation. William C. Boeck, University of Wyoming.
8. Ophiotaenia testudo nov. spec. from Amyda (Trionyx) spinifera. Thomas Byrd Magath, Mayo Clinic.
9. Otacariasis in the fox. Wm. A. Riley, University of Minnesota.
10. A new venture in the field of practical parasitology. (Motion pictures.) B. H. Ransom, U. S. Bureau of Animal Industry.
*11. The host-parasite method of investigation and some problems to which it gives approach. M. M. Metcalf.
*12. The rôle of domestic chickens and pigs in the spread of hookworm disease. James E. Ackert, Kansas State Agricultural College.
*13. A study of the resistance of different hosts to Trypanosome infections. W. H. and L. G. Taliaferro.
*14. The anomalies in the group of blood infesting Trematodes. Horace W. Stunkard, New York University.
15. Some additional results obtained in the study of infectious anemia of horses. John W. Scott, University of Wyoming.
*16. Sporulation and development of the cysts in a new species of Myxosporidia, Lentospora ovalis. H. S. Davis, University of Florida.
*17. On the migration of the sheep lung worm, Dictyocaulus filaria. John E. Guberlet, Oklahoma Agricultural Experiment Station.
18. Studies on Spirochaeta duttoni in the tissues of its invertebrate host Ornithidorus moubata. E. Melville DuPorte, McGill University.
*19. A little-worked source for parasitc material. M. M. Metcalf.
20. A coelomic Coccidian of Tribolium. Wm. A. Riley and Laurene Krogh, University of Minnesota.

*21. On Leptotheca ohlmacheri, a Myxosporidian parasitic in frogs. R. Kudo, University of Illinois.

*22. Notes on two new species of Holostomidae. John E. Guberlet, Oklahoma Agricultural Experiment Station.

*23. Phases in the life history of a Holostome, *Cyathocotyle orintalis*, nov. spec., with notes on the excretory system of the larva. Ernest Carroll Faust, Peking Union Medical College, Peking, China.

I. COMPARATIVE AND GENERAL PHYSIOLOGY

*1. Mutual reactions of cell-bodies and pseudopodial fragments of Difflugia. Wm. A. Kepner and B. D. Reynolds, University of Virginia.

*2. Reactions to light of the earthworm, Lumbricus terrestris. Walter N. Hess, DePauw University.

3. The rate of metabolism of Paramecium with controlled bacterial food supply. Geo. T. Hargitt and Ruth L. Phillips, Syracuse University.

*4. The feeding reactions of Ambystoma tigrinum (Green). Albert Kuntz and Jose Zozaya, St. Louis University School of Medicine.

5. The rôle of the nervous system in the locomotion and renegeration of marine polyclads. J. M. D. Olmsted, University of Toronto.

6. A quantitative study of tarsal sensitivity to solutions of saccharose in the Red Admiral butterfly, Pyrameis atalanta (Linn). Dwight E. Minnich, University of Minnesota.

*7. Micro-Winkler method for quantitative determination of dissolved oxygen. E. J. Lund, University of Minnesota.

8. A contribution to the colloid chemistry of protoplasm. L. V. Heilbrunn, University of Michigan.

*9. Transplantation of the pars nervosa of the pituitary. W. W. Swingle, Osborn Zoological Laboratory, Yale University.

*10. Photic orientation in the robber-fly, Proctacanthus. S. O. Mast, The Johns Hopkins University.

11. Light and growth in animals. A. G. Huntsman and F. Fraser, University of Toronto.

*12. "Reversal of inhibition" in insects, by atropine. W. J. Crozier, Rutgers College.

*13. Electrical polarity in Obelia. E. J. Lund, University of Minnesota.

*14. Circus movements in negatively heliotropic Limax. W. J. Crozier, Rutgers College, and W. H. Cole, Lake Forest College.

*15. The effect of locomotion in Ameba. I. Reactions to localized stimulation. J. Graham Edwards, The Johns Hopkins University. (Introduced by S. O. Mast.)

*16. A quantitative study of the reactions to light in Ameba. Harry T. Folger, The Johns Hopkins University. (Introduced by S. O. Mast.)

17. The influence of temperature on the rate of locomotion in Ameba. Alphonse M. Schwitalla, St. Louis University. (Introduced by S. O. Mast.)
(Papers received and abstracts ordered printed by vote of the Section)

18. The reflex produced by chemical stimulation of the deeper respiratory passages. E. Horne Craigie, University of Toronto.

19. The instincts and adaptations of several species of Tortugas fishes. W. H. Longley, Goucher College.
*20. Hen feathering in male fowls by feeding thyroid. Benjamin Horning and Harry Beal Torrey, University of Oregon Medical School.

J. UNCLASSIFIED PAPERS

1. The National Research Council Information Service. Robert M. Yerkes.
2. A Rare Example of Fish Teratology in Bicephalous Shark. E. E. Prince, Dominion Commissioner of Fisheries. (Introduced by W. C. Allee.)

SYMPOSIUM ON ORTHOGENESIS

1. Orthogenesis from the Standpoint of the Biochemist. L. J. Henderson.
2. Orthogenesis in Bacteria. C. B. Lipman.
3. Orthogenesis in Serological Reactions. M. F. Guyer.
4. Orthogenesis as Observed from Paleontological Evidence. H. F. Osborn. (Discussion by J. C. Merriam).
5. General Discussion. William Bateson.

EXHIBITS

1. Charts illustrating the elimination of the sex-chromosome from Drosophila by X-rays. James W. Mavor, Union College.
2. Charts and Diagrams illustrating the circulation of water in the Bay of Fundy and the Gulf of Maine. James W. Mavor, Union College.
3. A chart showing drift bottles which have crossed the Atlantic from the Canadian Coast since the summer of 1919. James W. Mavor, Union College.
4. The nuclei of the vitellaria of hydatina. H. J. Van Cleave, University of Illinois.
5. A demonstration of decerebrate rigidity, flexion and crossed extension reflexes, reciprocal innervation and inhibition in the cat. J. M. D. Olmsted and W. P. Warner, University of Toronto.
6. A demonstration of Paramecium calkinsi, sp. nov. L. L. Woodruff, Yale University.

ABSTRACTS

A. EVOLUTION AND GENETICS

PAPERS FROM THE BOTANICAL SOCIETY OF AMERICA

1. The synthesis of full-coloration in Phlox. JAMES P. KELLY, State College, Pa.

In the issue of Genetics for March, 1920, the writer published data on color of flower blade in Phlox Drummondii. Certain F_1 purples that were full-colored and self-colored gave an F_2 group of several blade types, i.e., full-colored selfs, lighter colored selfs, stippled dusky type, and white-bladed type. The F_3 results showed that the second and third types never gave rise to each other in progeny, while the first might throw out the second and third types besides repeating itself. Such analysis led to inference that full color was due to presence together of second and third types, or, rather of the genes for these types. In the present communication the writer reports the synthesis of full-colored selfs by the putting together in hybridization of the second and third types mentioned above.

2. Variation and mutation in Pestalozzia Guepini Desm. CARL D. LA RUE.

The length of spores of Pestalozzia Guepini varies from generation to generation. A generation with long spores is followed by two or three generations with spores of reduced size, after which another long-spored generation appears. Fluctuations of a similar type have been found by other workers and have usually been attributed to environmental influences. In Pestalozzia the variations appear to be independent of fluctuations in environmental factors. They are likewise independent of the composition of the nutrient medium. One strain of Pestalozzia Guepini gave rise to a mutation differing markedly from the parent strain both in spore characters and in vegetative development. From this mutation another originated with vegetative characters like those of the original strain but with spores identical in size and appearance with those of the first mutant. In another strain a mutation arose originated which differs from the parent strain in vegetative characters only.

3. Correlated inheritance in wheat of winter-spring habit of growth and rust resistance. (Charts.) OLAF S. AAMODT. Cooperative investigations between the Office of Cereal Investigations, U. S. Dept. of Agriculture, and the Department of Agriculture of the University of Minnesota.

The study is one of the steps leading toward the production of a rust-resistant spring wheat. The parental varieties, Kanred and Marquis, belong to Triticum vulgare. Kanred, a winter wheat, is resistant to several biologic forms of Puccinia graminis tritici (Ericks. & Henn.) to which Marquis, a spring wheat, is susceptible.

At University Farm, St. Paul, Minnesota, the Kanred parent, when planted in the spring, produces only an occasional head late in the season which fails to set seed. The F_2 Kanred-Marquis cross was planted in the spring and the plants

were placed in nine groups according to time of heading. Seven of these groups set seed and were tested in F_3. All individuals of the earlier heading F_2 group bred true for spring habit of growth. In the other six groups in F_3 the percentage of spring plants was in direct relation to the time of heading of the F_2 group.

F_3 seedlings of each F_2 group were inoculated, in the greenhouse, with a single known biologic form of rust. The segregation approximated a ratio of three resistant to one susceptible plant. The ratio of resistant to susceptible plants was approximately the same for all heading periods. Preliminary tests indicate that the reaction to several biologic forms was inherited as a single genetic factor.

4. Studies on the pollen tubes and abortive ovules of the globe mutant of Datura. J. T. Buchholz and A. F. Blakeslee, University of Arkansas.

A technique of dissection was developed which enables us to stain and count nearly all of the pollen tubes within the nutritive tissue of the style. The pollen from Globe produces upon germination two groups of pollen tubes, those that grow rapidly, and others that grow more slowly, as indicated by the bimodal curve of pollen tube distribution in the style. A large number of abortive ovules are produced in Globe selfed, in Globe Normal, and quite a few even in Normal × Globe, the latter indicating that probably a number of pollen tubes transmitting the Globe character actually reach the ovary above the small number of Globe seeds produced by this cross. Counts have been made of the pollen applied, the residue of ungerminated pollen grains on stigma and the residue of pollen tubes remaining in the style after abscission, from which the number of pollen tubes entering the ovary may be estimated.

5. The linkage relations of the factors for shrunken endosperm Sh sh, waxy endosperm Wx wx, and the aleurone color factors C c and I i in maize. C. B. Hutchison.

It has been shown previously by other investigators and by the writer that the factors for waxy endosperm *Wx wx* and shrunken endosperm *Sh sh* and two of the factors concerned in aleurone color, *C c* and *I i* in maize are linked. Results are here reported from two backcross experiments, the one involving shrunken and waxy endosperm and the *I i* color pair, the other shrunken and waxy endosperm and the *C c* color pair, which are interpreted as showing that the order of the genes are *I Sh* and *Wx*, and *C Sh Wx*. The per cent of crossovers between *I* and *Sh* is practically the same as that between *C* and *Sh*. *C* and *I* must therefore be allelomorphic or very closely linked.

6. Studies of somatic mutations in variegated maize pericarp. I. R. A. Emerson: Relative frequency of dominant somatic mutations in homozygous and in heterozygous variegated pericarp. 15 minutes. (Lantern.) II. W. H. Eyster and E. G. Anderson: Frequency of mutation in relation to development. 10 minutes. (Lantern.) III. E. G. Anderson and M. Demerec: An interpretation. 10 minutes. (Lantern.)

It has been shown previously that there occur, in races of maize with variegated pericarp, somatic mutations from the recessive variegated type to the dominant self-color type, the areas affected varying from a part of a seed to the whole ear. Two types, one inherited and the other not inherited, have been recognized. It has been pointed out that homozygous material, having the recessive variegation factor duplex, might be expected to mutate twice as frequently as hetero-

zygous material having that factor simplex. Results are here reported, showing on the contrary that somatic mutations occur consistently with greater frequency when the variegation factor is simplex than when it is duplex. Tabulation of progenies derived from a gene for variegation shows a high frequency of mutation in both directions, i.e., to self-color and to white. A gene for light variegation mutates frequently to white but rarely to self-color. A gene for dark variegation mutates rarely to white but frequently to self-color. The self-color derivatives show occasional reverse mutations to variegated. The mutations from variegated to self-colored affect both the germ cells and somatic tissue. The effect of a mutation on the somatic tissue of pericarp and glumes is visible as a colored area. The small colored areas are supposed to be due to mutations occurring relatively late in ontogeny, earlier mutations giving rise to larger colored areas. If mutability remains constant the frequency of observed mutant areas of each size should be roughly proportional to the relative number of cells present at the respective stages at which the mutations occurred. Tabulations of about 45,000 observed mutant areas of different sizes show a great increase in mutability in the later stages. This is believed to be causally related to increasing differentiation.

7. The inheritance of shape in the summer squash. EDMUND W. SINNOTT.
(No abstract received.)

8. Three new mutations in Oenothera Lamarckiana. GEORGE H. SHULL.
The origin and characteristics of the following new mutations are described: 1) Oenothera Lamarckiana mut. funifolia has strongly revolute leaves and is regarded as a parallel mutation in relation to Oenothera pratincola mut. formosa Bartlett. 2) Oenothera Lamarckiana mut. pervirens differs from the parent in having stems and buds wholly devoid of red pigmentation. 3) Oenothera Lamarckiana mut. vetaurea has flower color modified to a pale old gold color, the only previous departure in flower color in the Oenotheras having been to a pale yellowish white known as sulfurea. All three of these mutations are recessive to the parental type and at least (1) and (3) originated as new gene-mutations. Mut. pervirens may possibly have been produced as result of a crossover.
More papers dealing with plant genetics will be added later.

A′. PAPERS FROM THE AMERICAN SOCIETY OF ZOÖLOGISTS

1. Relative nuclear volume and the life-cycle of Hydatina senta. (Lantern.)
A. FRANKLIN SHULL, University of Michigan.
The ratio of nuclear volume to cytoplasmic volume, held by many biologists to be of importance in relation to regeneration, age, embryonic development, general cell physiology, sex, and other phenomena, was regarded by Hertwig, Issakowitch, Papanicolau and others as determining the form of the life-cycle in animals which reproduce alternately by parthenogenesis and bisexual reproduction. The rotifer Hydatina offers unusual material for testing this hypothesis. If the theory is correct, the relative nuclear volume should change to correspond with the periodicity of male-production that exists in most lines of this rotifer. Also since male-producers are more common in the middle of a family than at either the beginning or end of it, the nuclear volume should be relatively greater

in middle-aged females than in either young or old adults. Furthermore, those environmental agents (chemical substances, manure solution, food, etc.) which alter the life-cycle should also alter the relative nuclear volume. While significant changes in the volume of the nucleus have been discovered, these changes do not accord with the theory. The relative nuclear volumes in the yolk gland increased during a series of generations, while those of the stomach-intestine decreased during the latter half of the same period. Relative nuclear volume of the yolk gland increased throughout the life of the individual, instead of decreasing after middle age as the theory requires. Manure solution altered the nuclear volume of the stomach-intestine in the direction opposite to that required by the theory, but did not effect the other tissues studied. Female-producers and male-producers appeared to have equal nuclear volumes.

2. The action of alcohol upon germinal material. (Lantern.) E. CARLETON MACDOWELL, Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York.

This paper presents a summary of various series of data obtained from white rats heavily dosed with alcohol fumes. Four groups of animals are considered: 1) those treated; 2) their untreated children; 3) their treated children; 4) their untreated children's untreated children. Judged by their behavior in a circular maze and by the size of their litters, all four groups show a small amount of inferiority in comparison with their respective controls. This result appears to support the interpretation that the alcohol has directly modified germinal material.

If the numbers of litters produced in the same periods by the tests and their respective controls are compared, it appears that the treated rats produced only 32 of the expected 91 litters, or 35 per cent of the controls' production. The treated offspring of these treated rats produced 65 per cent of the expected number; the untreated offspring of the treated rats produced 33 per cent more litters than expected and the untreated grandchildren produced 55 per cent more litters than expected. The treated rats grew more slowly than their controls; their treated children about equaled their controls in growth and weight; their untreated children were heavier than their controls and their untreated grandchildren showed a less positive tendency to surpass their controls. The results from weight and the number of litters appear to show that the alcohol has acted as a selective agent upon a series of genetic differences present in the original animals.

3. Parallelism in Ascidians, with a new conception of organic structure. A. G. HUNTSMAN, University of Toronto.

Ascidians in general and the family Styelidae in particular offer a very good example of parallelism in the evolution of body-form. In that family the outstanding case is the repeated appearance in distinct genera of a peculiar stalked type. The interpretation offered is that the lines along which evolution has passed have been limited, not by selection, but by the structure of the ancestral germ-plasm. A working conception of the structure of living matter is needed. At present we have knowledge, 1) of the visible structure and, 2) of the chemistry of decomposition products of living matter. These may be loosely connected by considering that corresponding with the definite unity of a living mass there is an

enormous, complex, and ever-changing molecule, which is the foundational and essential part of the mass, and with which are more or less closely associated the numerous simple 'lifeless' molecules of which we have knowledge.

4. Effect of temperature upon the development of the eye of (variable), a mutant from Drosophila hydei. Roscoe R. Hyde, Johns Hopkins University.

The eggs from a new eye mutant, variable from Drosophila hydei (Sturtevant) when developed under warm, dry conditions give rise to flies with very small eyes. In fact, the eyes of some individuals may be entirely missing. When the eggs are subjected to a temperature below that of the living room and well supplied with moist food, the flies that emerge have large eyes, indistinguishable from the wild type. The eyes of the wild stock from which mutant came are not modified by changes in temperature. The new eye character is a non sex-linked recessive and shows linkage with scarlet, another mutant of this species. The two characters show crossing over in the female but not in the male.

5. Heritable effects of chemically differing media on the fission rate of Paramecium caudatum. A. R. Middleton, University of Louisville.

Can we change the living system by chemical means so that the change will persist in to later generations? To attack this question the organism employed was Paramecium caudatum and the character considered is the highly modifiable but heritable fission-rate. For one hundred and thirty days two sets of twenty lines each comprising the two halves of a single clone of Paramecium caudatum were kept, one set in 1/32 per cent Horlick's Malted Milk prepared with distilled water and the other in 1/32 per cent Horlick's Malted Milk prepared with 2/10 per cent normal saline. After ten, twenty, thirty, forty, and eighty days' exposure to these chemically diverse environments the two sets were duplicated and kept for ten, twenty, sixty, ninety and fifty days, respectively, in 1/10 per cent normal saline malted milk. During the thirteen ten-day periods of the main experiment the saline lines divided characteristically more rapidly than the distilled-water lines. This relatively faster rate of division of the saline set persisted during ten days' cultivation in intermediate saline subsequent to ten days in extremes, during twenty days in intermediate saline subsequent to twenty days in extremes, and during sixty days in intermediate saline subsequent to thirty days in extremes. An exposure of forty days or longer to extremes produced the reverse effect when the duplicate sets were cultivated in intermediate saline. This result may be due to some undetectable injury resulting from long-continued exposure to relatively high salinity.

6. Heredity of resistance to tuberculosis in guinea-pigs. (Lantern.) Sewall Wright and Paul A. Lewis, Bureau of Animal Industry, and Phipps Institute.

The resistance to tuberculosis has been tested in over eleven hundred guinea-pigs belonging to five closely inbred families, the crosses between these families and a random bred control stock. It has been found that sex, and even three-fold differences in age, rate of gain, and weight have only a slight effect on length of life after inoculation. In striking contrast to these negative results, are the great differences among the inbred families, differences which are not correlated with the differences in fertility, weight and vitality. The progeny of crosses are in general at least equal to the better of the two parental families. Resistance

is thus dominant over susceptibility. There is equal transmission by sire and dam and to sons and daughters. In particular crosses, the average of the progeny is consistently superior to either parental line, indicating that the latter are susceptible for different reasons, each being able to supply a dominant resistance factor lacking in the other. In the whole crossbred stock, over 30 per cent of the observed variation is determined by the amount of blood of the best inbred family, as compared with less than 10 per cent due to age, weight and rate of gain combined, and leaving about 60 per cent due to conditions at or following inoculation.

7. *Data on the inheritance of spurs in female fowl.* H. D. Goodale, Massachusetts Agricultural Experiment Station.

By selection, a race of fowls having spurred females has been produced. Two of these were crossed with a race (Cornish) in which the females are never spurred. F_1 is spurless. Segregation occurred in F_2, the ratios indicating more than one set of mendelian factors.

8. *Heredity of build.* (Lantern.) Charles B. Davenport, Station for Experimental Evolution, Cold Spring Harbor.

A consideration of the best quantitative expression of build; the environmental and general physiological factors influencing build. The hereditary factors determining build and their method of action, together with some discussion of the interdependence of the general physiological and hereditary factors.

9. *Effective reverse selection in bar eye of Drosophila due to the appearance of mutations.* (Lantern.) Charles Zeleny, University of Illinois.

Reverse selection started in the 34th generation of the high line of the white-bar series was continued for seven generation. An effective decrease in mean facet number was obtained in the first two generations of both females and males and in the seventh generation of the females. The results are due to the appearance of two mutations, one, the ultra-bar, which has been observed on several other occasions and the other a factor which causes a return of the mean to that of the unselected population. While the prevalence of lethal factors in the direct line of the selection stock suggests that the effectiveness of reverse selection may be due to their presence, all the evidence cannot be brought into agreement with such a view.

10. *Genetic mosaics and ontogenetic abnormalities in the parasitic wasp, Hadrobracon.* (Charts.) P. W. Whiting, University of Iowa.

Genetic differences are orange eye-color, completely recessive to black and defective venation, irregularly recessive to normal. Normal inheritance is sex-linkoid. Sexes are readily distinguished by antennae, abdominal sclerites, and external genitalia. Patroclinous and mosaic males have all external characters and usually gross internal anatomy normal for male. They are regularly produced in variable percentage from cross of black male by orange female. Much more rarely they arise from black female by orange male, but these have thus far been patroclinous for wing character only. They are usually sterile, but if fertile transmit either paternal or maternal characters. In one case both were transmitted and male bred like a zygote. A single sterile male with orange eyes and black ocelli arose from hetorozygous female crossed to black male. Only two

gynandromorphs have been found. One was female except for one-half of the abdomen which was clearly male. The other had anterior half male, posterior female. Mosaic males may be due to failure of nuclear fusion at fertilization. Gynandromorphs arise from mixture of haploid and diploid tissue. The male which bred like a zygote may be tentatively explained as a sort of gynandromorph. Certain variations affecting external genitalia produce what was at first thought to be 'intersexes.' These have now been shown to be accidents of growth not correlated with sex.

11. Olive, a mutation in Colias philodice. JOHN H. GEROULD, Dartmouth College.

Olive-green caterpillar color is recessive to normal grass-green. The eye of the butterfly developed from an olive-green caterpillar is not normal yellow-green, but olive-green. That the recessive gene probably adds to the normal grass-green hemolymph an orange pigment not yet detected in the blood itself, or at least a determiner of such pigment, is demonstrated by the fact that certain wing scales of the mutant butterfly always show a peculiar orange or buff pigmentation, not normal in this species. This orange pigmentation is most marked on the under surface of the hind wings and of the tip of the fore wings, parts most directly exposed during wing development in the pupa to the action of the hemolymph. The orange-producing gene for 'olive,' acting through the blood upon the grass-green pigment derived from chlorophyl and passed on by the blood to the hypodermis of skin (larva) and eye (butterfly), turns this pigment olive-green; the altered hemolymph, acting upon the wing scales, turns them orange. This gene interacts with another recessive factor, viz., that for blue-green blood and caterpillar color, to give a 9:3:4 ratio (9 grass-green, 3 olive-green, 4 blue-green). The delicate purple sheen that appears in the skin of certain blue-green caterpillars (with blue-green blood) probably indicates the presence and action in them of the recessive olive factor. 'Olive' × 'olive' breeds true, but certain individuals heterozygous for blue-green produce 25 per cent of blue-green caterpillars.

12. Incomplete synapsis of chromosomes and its possible relation to linkage variations. (Lantern.) C. W. METZ, Carnegie Institution of Washington.

In flies of the genus Dasyllis certain chromosome pairs appear to undergo incomplete synapsis during spermatogenesis, with the result that certain parts of the chromosomes remain well separated throughout the spermatocyte growth period. The process is uniform and constant in these particular chromosomes, which can be identified by their size and shape. Such chromosome behavior recalls the genetic behavior of the low crossover strains of Drosophila melanogaster (Sturtevant, Detlefsen) in which crossing over is greatly reduced or eliminated in certain 'regions' of particular chromosomes. One simple assumption that might account for this result is that of incomplete synapsis in the chromosomes involved. Unfortunately, Drosophila is not favorable for a cytological study of this question and Dasyllis is unsuitable for genetic analysis, so that the two lines of evidence cannot, as yet, be obtained in the same animal. However, the data from Dasyllis leave little doubt on one of the main points, namely, that synapsis is not necessarily uniform but that different parts of a chromosome may differ radically in this respect. This fact lends support also to the hypothesis that the grouping or clumping of genes in the chromosome maps

of Drosophila may be due to differences in the intimacy of synapsis in the corresponding regions of the chromosomes.

13. A cross in guinea-pigs best explained by assuming 75 per cent crossing over. (Lantern.) HEMAN L. IBSEN, Kansas State Agricultural College.

The factors involved are *P*, dark-eyed, *p*, pink-eyed; *Cr*, non-yellow, *Ca*, albino; e^p, tortoise, partial extension of black, *e*, non-extension of black. Two crosses were made: 1) A pink-eyed self-white, *pp ee Cr Cr* was crossed with a 'dark-eyed' albino, *PP ee Ca Ca*, and the dark-eyed self white offspring, *PP ee Cr Ca*, were inbred, producing 120 dark-eyed self whites and 64 which were either albinos or pink-eyed self whites. 2) A pink-eyed self white, *pp ee Cr Cr* was crossed with a 'dark-eyed tortoise' albino, *PP* e^p e^p *Ca Ca* and the dark-eyed non-yellow tortoises, *Pp*^{p} *e Cr Ca*, were inbred, producing 51 dark-eyed non-yellow tortoises 6 pink-eyed non-yellow tortoises (*pp* e^p *Cr*), 16 dark-eyed self whites (*P ee Cr*) and 38 pink-eyed self whites or albinos.

The first cross was made to determine whether a 9:7 ratio would be obtained in the F_2, and the second, whether a 27:8:9:19 ratio would be obtained. Neither was closely approximated. However, by assuming that *P* and *Cr* were linked, and that 75 per cent crossing over took place in both sexes, it was found that the theoretical ratio (41 dark-eyed : 23 pink-eyed or albinos) fairly closely approached the observed ratio. If in addition one assumed that e^p was not linked to the other two factors, the theoretical ratio for the second cross (123 dark-eyed non-yellow tortoises : 41 dark-eyed self whites : 21 pink-eyed tortoises : 71 pink-eyed whites or albinos) was also found to be fairly close to the observed ratio. This hypothesis is tentative. Final proof can be obtained only by mating the heterozygotes back to recessives.

14. A linkage diagram of nine factors for color patterns in Apotettix eurycephalus Hancock. ROBERT K. NABOURS, Kansas Agricultural Experiment Station.

The recessive, gray normal (primitive, or wild type) and nine dominant color characters, all from nature, are as follows: +/+ = grey normal; M/M = V-pattern; Y/Y = white-spot; O/O = white-all-over; R/R = yellow-all-over; W/W = yellow-striped-femora; Z/Z = brown-tipped-femora; G/G = brown-stripe; K/K = white-stripe; T/T = red-all-over (American Naturalist, 1919). During the ten years of the experiment, breeding bisexually and parthenogenetically, these factors have been paired 200,942 times in the females, ranging from 15,142 pairings of R and K to 1,794 of O and W (crossing over occurs only to a negligible extent in males). M and Y are nearly, if not exactly, allelomorphs. O, R, W and Z, forming a group of multiple allelomorphs, average 5.82 per cent of crossing over with M and Y, G, K and T, each allelomorphic to the other, average 0.63 per cent of crossing over with the O, R, W, Z group. The average direct crossing over between M and Y and the G, K, T group amounts to 6.12 per cent. The difference between this longer distance and the sum of the two shorter, amounting to 0.33 per cent may partly be accounted for by double crossing over, which infrequently occurs. There are considerable divergences among several pairs in the crossing over percentages, and wide divergences among given pairs between the percentage of linkage, or coming together, and the percentage of separating, or crossing out.

15. Genetic analysis of low crossover stock, produced by selection. J. A. Detlefsen and L. S. Clemente, University of Illinois.

A stock of Drosophila melanogaster produced by selection and giving about 5 to 6 per cent crossing over between red eye and long wing vs. white eye and miniature wing was mated to a stock of white eye, crossveinless, cut-wing, miniature, forked. The results of the F_1 and F_2 show that: 1) One of the two homologous chromosomes alone has been affected, namely, the one carrying red-eye and long-wing. The other chromosome carrying white-eye and miniature-wing was apparently unaffected by selection. 2) The regions from red to cross-veined and from cross-veined to not-cut are about 13 and 7 units long, respectively, but in our low selected series these regions have been very greatly reduced, perhaps to less than one unit. The region from not-cut to long-wing is about 16 units normally, but has been reduced to about one-fourth of this value. The region to the right of long-wing up to not-forked has been slightly reduced in crossover value, although this region was not involved directly in the process of selection. The total distance between red-eye and long-wing is about 33 units normally but in our low series it has been reduced to 5 units, or at least the percentage of crossing-over is about 5 per cent. Comparison of F_1 and F_2 distributions show that the latter are more variable.

16. Ten years with the self-fertilized line of Lymnaea columella, Say. Harold Sellers Colton, Zoological Laboratory, University of Pennsylvania.

On the night of February 4, 1911, a pond snail from a tank in the vivarium of the University of Pennsylvania laid a mass of eggs. The young snails hatching from those eggs were isolated from one another and so prevented from mating. Although cross breeding was prevented, yet for forty-seven generations the line has continued to live because the snails self-fertilize their own eggs. Extending over a period of almost ten years inbreeding of the very closest sort has been practiced, resulting in an animal of great theoretical gametic purity; greater perhaps than any other animal which reproduces sexually. This line of snails agrees with the experience of King, Wright, and others, namely, that inbreeding does not appreciably affect the viability of the race.

17. Results of eight years of inbreeding of Rhode Island Red fowls. (Lantern.) L. J. Cole and J. G. Halpin, University of Wisconsin.

Selection on the basis of a non-vital character (plumage color) resulted in a rapid deterioration of the stock, which ran out completely in four years. Egg production was affected to some extent, but the deterioration was particularly noticeable in vitality, as measured by hatchability of the eggs. In a second phase of the experiment the inbreeding has been of the same intensity, but selection has been based on vigor, as measured by good hatchability and strong vigorous chicks. This has resulted so far in raising the general vitality of the stock, though there appears to have been a loss in egg production, which has not been considered directly in the selections. The results can be interpreted as due to the inheritance of lethal, semilethal or physiological-defective factors, though no such have as yet been experimentally isolated.

18. Inheritance of color in the domestic turkey. (Continued.) W. R. B. Robertson, University of Kansas.

In 1920 a black male was bred to a bronze female. The F_1 generation was black except for a few barred feathers among the coverts of the tail. Also a narragansett male was bred to a bourbon red female. The F_1's were much like the narragansett, but showed distinctly the influence of the red in increased amount of the red or auburn in the feathers. In 1921 an F_1 black (bronze) male was mated to three F_1 Narragansett-red females. In F_2 there were 4 black males and 2 black females (all showing a very few barred-pattern feathers among the tail coverts), 2 rusty black males showing more traces of barring than in the black, 1 bronze male and 6 bronze females, and 4 bronze-red males and 2 bronze-red females. The classes theoretically should be black (narragansett), black-red, bronze (narragansett), and bronze-red. All classes are represented. The small numbers may account for the absence of females in the black-red. The experiment shows that the narragansett pattern is an additional allelomorph. The series is black, bronze, narragansett, and bourbon red. This order also indicates their relative dominance, black being most dominant, bronze next, etc. Bronze seems to be completely dominant to narragansett.

19. Orthogenesis of non-homochromic pigmentation in chromodorids. W. J. Crozier, Rutgers College.

In all species of Chromodoris for which color descriptions exsist, indication is had of the presence of two distinct types of integumentary pigments. One of these substances has a characteristic band absorption spectrum and other properties permitting ready identification. As obtained from different species (Bermuda, California), this substance is found to be chemically very similar, perhaps identical. Since the habits of the various species are different, the relation of coloration to habit may be interpreted in accord with modern genetic views of adaptation.

20. Breeding experiments with the viviparous teleosts, Xiphophorus helleri and Platypoecilus maculatus (Günth.). A. W. Bellamy, University of Chicago.

The material is admirable for studies pertaining to heredity of physiological and morphological characters; sex-differentiation; and experimental evolution. X. helleri is conspicuously marked by a lateral red stripe and other minor color variations. Dorsal fin has 13 ± 1 rays. A ventral prolongation of the caudal ('sword-tail') is characteristic of males. Form-index—body length/greatest depth—3.5 for males; 3.0 for females. P. maculatus presents four color varieties: 'rubra,' 'nigra,' 'pulchra,' (spotted), 'plain.' Dorsal fin has 10 ± 1 rays. Form-index for males and females approximates 2.7. In males of both genera the anal fin becomes modified (X. helleri, 136 ± 60 days; P. maculatus, 141 ± 80 days after birth) to form an intromittent organ. Sex ratios are very erratic, especially in X. helleri which averaged (317 fish) 100 males to 67.7 females; P. maculatus, (669 fish) 100 males to 147.7 females.

Most of the possible straight, reciprocal, and back-crosses have been made. Only general results from the cross: 'nigra' male and X. helleri female can be given here. F_1 hybrids are uniform and deep greenish black much darker than darkest parent. (True of most black hybrids.) One mating gave 8 males, 1

female; another 0 males, 10 females; another 6 males, 0 females. Dorsal fin rays, 11–12. Males have small 'sword'—a male secondary sex character inherited through the female, as Gerschler showed. F_2: one mating gave variable greenish blacks, males 12; females 30; variable whites, males 30, females 5. Two blacks approximated the 'nigra.' Several white males show the 'sword.' A peculiar type of sex-linked inheritance is indicated in this and other crosses. Most F_1 hybrids are fertile; many F_2 and sesqui-hybrids are sterile. Intersexes occur. Form indices vary from one extreme to the other in both sexes.

21. The elimination of the sex-chromosome by x-rays: A modification of the germ plasm produced by an external agent. James W. Mavor, Union College.

Homozygous, wild type, virgin female Drosophila were treated with x-rays and mated to white-eyed males. None of nineteen control pairs produced any white-eyed flies, although they produced over 6500 offspring. Twelve out of fifteen treated females produced white-eyed males.

22. Hybrid vigor, hybrid weakness, and the chromosome mechanism of heredity. An experimental analysis of the physiology of heredity in the reciprocal crosses between two closely associated species of sea-urchins, Strongylocentrotus purpuratus and S. Franciscanus. H. H. Newman, University of Chicago.

Much has been written of late about hybrid vigor, in interspecific F_1 hybrids, especially among plants. East and Jones have attempted to explain the added vigor of such hybrids as due to the summation in the hybrid of the dominant or favorable characters of the two species. They imply that all F_1 interspecific hybrids exhibit hybrid vigor. The writer has for a long time called attention to the fact that, in every lot of cross-fertilized eggs, weak and defective individuals are as obvious as are those that show hybrid vigor. In 1908 the writer explained the extra vigor of the surviving Fundulus hybrids as the result of the chance combination of the more favorable or dominant specific characters, and the relative lack of vigor of other individuals as the result of less favorable combinations of specific characters.

In Echinoderm hybrids, as in Teleost hybrids, the entire history of large groups of individuals can be followed from fertilization to a definitive larval condition. In the cross, Strongylocentrotus purpuratus ♀ × S. franciscanus ♂ there is frequently very pronounced hybrid vigor associated with extreme hybridity in many positive larval characters; yet there is also equally prevalent hybrid weakness. In the reciprocal cross there is no hybrid vigor, but only hybrid weakness, and very little, if any, paternal heredity. These facts form the basis of certain theories of heredity that cannot be put forth in an abstract. It is, however, the writer's belief that they are compatible with current theories of the chromosomal mechanism of heredity.

23. Changes in egg production at the Massachusetts Agricultural Experiment Station. H. D. Goodale, Massachusetts Agricultural Experiment Station.

A history of the steps taken to date. Egg production has been increased by selection, based on the consideration that at least five major components can be recognized in one egg record, namely, maturity, winter pause, broodiness, intensity, and date of last egg. Thus far, attention has centered on decreasing the average age at which the first egg is laid, the decrease being fifty-eight days, with

corresponding increase in winter production. Broodiness has also been reduced. The mean annual production has been increased from 121 to 185 eggs.

24. Variations in the number of vertebræ and other segmental characters of fishes correlated with the temperature of the water during development. Carl L. Hubbs (introduced by L. V. Heilbrunn), Museum of Zoology, University of Michigan.

The writer for a number of years has been studying the correlation between altered environmental conditions and the number of vertebrae and other segmentally arranged structures in fishes. Johannes Schmidt has been carrying on a series of intensive investigations which deal with the same problem, and which are for the greater part rather closely paralleled by the writer's studies. Both of us have obtained, independently, a rather large volume of experimental and observational evidence indicating that the meristic characters displayed by an individual fish are determined not alone by heredity, but in part also by the environmental conditions, notably temperature, which prevail during some sensitive developmental period. We have further demonstrated that altered environmental conditions induce differences highly similar to those which characterize local races in fishes, some of which have been proved genetically distinct. For example, differences induced by cold are in the same direction as those characterizing races inhabiting cold water. The writer is planning a series of investigations by which he hopes to arrive at an explanation of these phenomena.

B. EMBRYOLOGY

1. Cell behavior in tissue cultures. (Lantern.) H. B. Goodrich, Wesleyan University.

1. A non-amoeboid type of cell motion.—A study has been made of a peculiar mode of motion of certain isolated cells observed in tissue cultures of Fundulus heteroclitus and F. majalis. These cells are identical with those observed by Doctor Dederer (paper in press) and identified as mesenchyme cells. These cells are described as having peculiar fan-like expansions by which they are anchored to the cover-glass. The present observations indicate that these fans form the motor organs of the cell. The motion is apparently not amoeboid. The fan seldom changes in form while in motion and it has the consistency of a colloid gel. It is a delicate membrane which glides on the under surface of the coverslip and pulls after it the body of the cell. The maximum observed rate of motion was 6μ per minute.

2. Tactile reactions. Experiments utilizing the micro-dissection needle show that the cell body may be touched by the needle and thus be stimulated to release the fan and to contract. The tactile reactions of the pigment cells have also been studied. The black melanophores, red chromatophores, and yellow chromatophores form a series, in order named, of increasing tactile response (as shown by withdrawal of pseudopodia) to the touch of the micro-dissection needle.

2. Experiments with Necturus and axolotl thyroids. W. W. Swingle, Yale University.

1. Adult Necturus were fed large quantities of physiologically active thyroid, anterior lobe pituitary and simultaneously transplanted with frog thyroids. Results negative at the end of four months despite the enormous thyroid dosage.

2. Thyroids of untreated Necturus were transplanted into immature R. clamata larvae without limbs. Ten to fourteen days later the larvae presented the symptoms of hyperthyroidism, such as fore and hind leg development and practically complete tail atrophy. Despite its larval characters Necturus possesses highly active thyroid glands and seems to have lost the ability to transform, under stimulus of thyroid feeding.

3. The thyroids of an axolotl 14.25 inches long and at least four years of age were transplanted into R. clamata larvae without limbs. The glands were large, vascular, and the vesicles distended with a fluid, presumably colloid. The glands were cut into six parts and six larvae grafted. One tadpole died two days later, the remainder showed the typical hyperthyroid reaction upon the eighth day. Two weeks from the date of grafting the larvae had fore and hind legs, and showed marked tail resorbtion. Thus a single axolotl thyroid when extirpated contains enough active hormone practically to metamorphose five tadpoles, but when left unmolested within the axolotl's body is incapable of initiating metamorphosis. Axolotl neoteny is apparently due to the inability of the thyroid gland to excrete into the blood stream its fully formed and physiologically active hormone. A releasing factor is lacking. Axolotls readily metamorphose when fed thyroid in large quantities. The pituitary of axolotl appeared normal; when transplanted, the gland was resorbed and results negative.

3. Chorionic fusion and augmented twinning in the human tube. Leslie B. Arey, Northwestern University Medical School.

The data from all known cases of human tubal twins indicate that the ratio of monochorial to dichorial specimens is about fifteen times greater in the tube than in the uterus. Illustrative stages are at hand which indicate that this disproportion results in part from the secondary fusion of the chorionic sacs of dizygotic individuals. Hence for man the term 'monochorial' need not always connote a single ovum origen. However, a still more potent factor appears to be an actual augmentation of the twinning impulse. Its cause is most clearly referable to tubal inflammation and its seqellae. The same delays and arrests which cause and follow tubal implantation are largely responsible for both the increased twinning and the excessive malformation of tubal specimens.

4. The influence of thyroid-gland feeding upon tadpoles from which the thyroid gland and the buccal anlage of the hypophysis have been removed. Bennett M. Allen, University of Kansas.

These experiments were performed upon Rana sphenocephala 1) normal controls; 2) controls cut as for hypophysis removal; 3) thyroidless tadpoles; 4) those deprived of the buccal anlage of the hypophysis, and 5) tadpoles deprived of both thyroid and buccal anlage were fed weighed quantities of sheep-thyroid preparations. The purpose was to determine whether the influence of thyroid feeding would be the same in each case. Tadpoles in young feeding stages were employed in lots of twenty-five. It appeared that the presence or absence of these glands in the tadpoles had little control upon the influence exerted by thyroid feeding upon limb development. The tail was not so quickly reduced as a result of administration of thyroid to groups 4 and 5 as in groups 1, 2, and 3. It is possible that future experiments in administering more diluted doses of thyroid prepara-

tions may prove a more delicate test. A study of the thyroid glands of controls and of tadpoles deprived of the buccal anlage of the hypophysis fails to show any modification of gland development or of colloid accumulation to result from thyroid feeding.

C. CYTOLOGY

1. A determination of the degree of constancy in the nuclei of certain organs in Hydatina senta. H. J. Van Cleave, University of Illinois.

Eric Martini ('12) maintained that each individual of Hydatina senta bears a fixed total number of 959 nuclei for the entire organism. A. F. Shull ('18), using serial sections, studied the vitellaria and gastric glands of this species to determine a measure of the exactitude of nuclear constancy. In 245 vitellaria he found 4 per cent which did not contain the customary eight nuclei. Over 7 per cent of the gastric glands examined by him displayed numbers of nuclei other than the characteristic six. Age, culture media, and male and female determining strains were considered, but there was no striking difference in the numbers of aberrant glands under different conditions of his observations. Subnormal numbers of nuclei were more frequently encountered than supernumerary and odd numbers were more frequent than even in the varients described by Shull.

An investigation of stained whole mounts, begun by the present writer soon after the appearance of Martini's monograph, has just been completed; 435 gastric glands were examined without discovering a single variant from the customary six nuclei in each. In 770 vitellaria, three were found with supernumerary nuclei, two with ten each and the third with twelve nuclei. Not a single subnormal number was observed nor were there any variants bearing odd numbers. Frequently vitellaria were observed with the number of nuclei normal but with unusual appearance, strongly simulating conditions in amitosis. Every aberrant individual encountered in this study presents evidences of an inconstancy superimposed upon an absolute constancy in nuclear numbers.

2. Further studies in the cytology of Anisolabis maritima, Bon. (Lantern.) S. I. Kornhauser, Denison University.

It was previously determined that the diploid chromosome number is 25 in the male and 26 in the female. Eleven tetrads and a hexad appear in the primary spermatocyte metaphase plates, whereas in the second spermatocytes half show 12 and half 13 dyads. A detailed study of the hexad was made. It was found to be an XXY complex made up of three distinct spermatogonial chromosomes. Unlike the 22 autosomes these three remain compact during the leptonema. The two X-chromosomes soon come to lie side by side and while the autosomes are conjugating the Y-chromosome approaches and is in contact with the two X-elements by a narrow strand. Parasyndesis of the autosomes being completed the Y-element now separates and remains apart from the XX-element during the zygonema and pachynema. The X-elements stain like chromatin, but the Y-element is lighter in chromatin stains, is vacuolated and after Benda fixation takes mitochondrial stains.

With the onset of the strepsinema XX and Y-elements fuse, and soon give off a spherule which stains like mitochondria and which gradually diminishes in size and disappears before the first meiotic spindle is formed. The XXY-hexad

comes out of the fused mass. From now on the Y-element reacts to stains exactly like chromatin. In the first meiotic division 11 autosomal dyads and the XX-element pass to one pole whereas 11 autosomal dyads and the Y-element pass to the opposite pole. During the interkinesis the two components of the XX-element separate so that half the second meiotic division plates show 13 dyads.

3. The occurrence of telosynapsis in the male germ cells of Leptocoris trivitattus, Say. (Hemiptera). HARRY B. YOCOM, University of Oregon.

In Leptocoris trivitattus, Say, the chromosome complex of the spermatogonium consists of thirteen chromosomes, ten autosomes, two 'M' chromosomes, and one accessory chromosome. After the last spermatogonial division all of the chromosomes except the accessory enter into a fine spireme which is tightly tangled toward the center of the nucleus. As growth of the primary spermatocyte proceeds this thread becomes thicker and unwinds, so that it fills the nucleus with a loosely convoluted thread. Near the end of the growth period this thread again contracts into a mass concentrated toward the center of the nucleus. There is no indication of any polarization or pairing of the thread during this period of synizesis. Later this spireme spreads out until it fills the nucleus with a lightly staining very diffuse work, the organization of which it was impossible to determine. The chromatin of this diffuse mass becomes condensed into a number of masses, probably twelve, which as they become compact unite end to end to form the bivalent chromosomes of the primary spermatocyte. Conjugation of the homologous chromosomes is therefore by telosynapsis. The accessory chromosome can be distinguished at all times during the growth of the spermatocyte by its compactness and rounded contour. At the first spermatocyte division which separates the homologous chromosomes, the accessory chromosome divides equally. At the second maturation division the accessory passes to one pole undivided.

4. Studies on the cells of sheep with special reference to spermatogenesis, oögenesis, and sex-determination. (Lantern.) J. E. WODSEDALEK, University of Idaho.

Thirty-three chromosomes occur in the spermatogonia. One, the sex-chromosome, is distinctly larger than the others. Seventeen chromosomes appear in the primary spermatocyte division, of which sixteen are bivalent and the other is the unpaired sex-chromosome. This division gives rise to two types of secondary spermatocytes since the sex-chromosome passes to one pole undivided. Finally two types of spermatids are produced. All of the spermatids contain the sixteen autosomes while only half of them possess the additional sex-chromosome. Thirty-four chromosomes occur in the oögonia; two of these are the sex-chromosomes. Seventeen bivalent chromosomes appear in the primary oöcyte division; one of these, clearly the largest, is the bivalent sex-chromosome. The reduced number of chromosomes in the female is sixteen autosomes and one sex-chromosome, the same number being thrown off with the first polar body. This takes place in the ovary while the oöcyte lies in the graafian follicle. Various stages of this process have been observed in a number of cases. The prevailing number of chromosomes in the somatic cells of male embryos and foetuses corresponds to the number present in the spermatogonia. While the number in the somatic cells of the female corresponds to the number present in the oögonia.

5. The structure and division of Trichomonas augusta alexeieff. D. H. Wenrich, University of Pennsylvania.

This flagellate, found in the rectum of many Amphibia, possesses the organelles characteristic of the genus: nucleus; cytostome; and the blepharoplast to which are attached a group consisting of three anterior free flagella, a posterior flagellum which is also the chromatic margin of the undulating membrane, the chromatic basal rod, the parabasal body and the axostyle. As in Trichomonas muris, the parabasal body appears only after certain fixatives such as weak Flemming's. The undulating membrane contains near the chromatic margin a secondary filament of small caliber. This is well shown after fixation with Bouin's fluid. During the prophase of division the nuclear chromatin gradually organizes into double (split?) chromosomes and a small new chromatic basal rod appears, attached to the blepharoplast. Later this rod is seen to be accompanied by a small new undulating membrane. The blepharoplast divides, the daughters separating but remaining connected by the chromatic paradesmose. In the metaphase plate seven double (split?) chromosomes can be counted which at first have their long axes perpendicular to the spindle axis but during separation become elongated parallel to the spindle axis. The axostyle becomes detached from the blepharoplast and gradually disintegrates. During the telophase the daughter nuclei become organized and a new axostyle grows out from each daughter blepharoplast. Excepting the blepharoplasts and nuclei, the new organelles needed to complete two sets appear to develop anew. When two complete sets of organelles have developed, the cell body divides.

6. Multinucleated germ cells in the Columbian ground-squirrel. (Lantern.) J. E. Wodsedalek, University of Idaho.

Cells containing two or four nuclei were rarely found by the writer in his studies on the male germ cells of swine, horses, cattle, and sheep, and a few cells with eight nuclei were observed in the cat. Multinucleated cells are much more numerous in the testes of the Columbian ground-squirrel (Citellus columbianus columbianus). Cells with two, four, and eight nuclei were occasionally found in the tissue taken from eighteen individuals. In the tissue taken from two individuals not only are the cells containing two, four, and eight nuclei plentiful, but cells with as many as sixteen and thirty-two nuclei, of the spermatid type, are fairly common. The two males concerned were vigorous specimens and their germ cells were extremely active. Numerous mature spermatozoa and others in the process of development were present. Other normal cells in the various stages of mitosis were also abundant in the immediate neighborhood of the multinucleated cells.

7. Seasonal changes in the testis of Gambusia affinis, the top-minnow. S. W. Geiser (introduced by S. O. Mast). The Johns Hopkins University.

The testes develop from the typical anlage. During early life, they are separate, except at their posterior ends; at the age of two to three months, they fuse more or less completely along the median line. The testis consists of fine connective-tissue stroma which becomes apparent as investments of the cysts when the testis is in active spermatogenesis. In adults the longitudinal testicular canal (vas deferens of German workers) is tubular, tortuous, usually paired,

but sometimes fused. Testes fluctuate in volume between summer and winter, but the fluctuation is not very marked (eight-fold volume-increase in summer, maximum found). Testes in Winter are filled with spermatozeugmata, which greatly swell the 'vas deferens,' so that it sometimes comprises 62.4 per cent of the volume of the testis, as compared with 1.2 per cent to 1.5 per cent at the high-point of spermatogenesis (May/June.) The testis does not possess cords of sex-cells for the renewal of the testis after spermatogenesis. There are no spermatic tubules. The spermatogonia develop apparently from inconspicuous germ-cells lying in the stroma of the testis, between the cysts. These cells migrate peripherally (outside the zone of the vas deferens) and give rise to new spermatogonial cysts. The period of greatest sexual activity (max. testis-volume) in early spermatogenesis is March/July. The onset of this period appears to be largely conditioned by temperature and light conditions. In November/February, the testes attain their minimum size. With the onset of cold weather, sexual activity ceases. No spermatogenesis occurs during the cold weather.

All the cells in a spermatogonial cyst are in approximately the same stage of spermatogenesis. A spermatozeugma may have from 5000 to 13000 spermatozoa.

8. Changes in the vaginal epithelium of the guinea-pig during the oestrous cycle. R. M. Selle (introduced by J. A. Long).

The oestrous cycle in the guinea-pig shows four clearly defined periods or stages, in addition to the interval, which correspond to similar stages in the rat. In the first stage, which apparently was overlooked by Stockard and Papanicolaou, the vaginal smear contains large, vacuolated, granular epithelial cells only. These epithelial cells are derived from the superficial layers of the mucosa beneath which cornification has been going on. The mucosa is highest at this time. In stage 2 the superficial epithelial cells are gone, leaving uppermost the cornified stratum. The latter by scaling off furnishes the typical, non-nucleated, flake-like cells of the smear. Up to this point the similarities of the rat are close. However, in the guinea-pig the whole cornified layer, not the whole epithelium, with some of the underlying non-cornified epithelial cells may be shed en masse like a cast. Whereas in stage 3 in the rat the granular, cheesy material consists of the elements of the cornified stratum, rapidly desquamated singly or in small groups until the stratum is entirely lost, in the guinea-pig the cheesy mass described by Stockard and Papanicolaou is constituted of the deeper-lying non-cornified epithelial cells which are shed in large numbers. In the last stage (4) leucocytes appear as described by Stockard and Papanicolaou in their stage 3. No state has been found corresponding to their 4. There is no evidence of any important contribution by the uterus to the cellular contents of the vagina, for the latter is practically identical in normal pigs and in hysterectomized pigs.

D. COMPARATIVE ANATOMY

1. Metamorphic changes in the digestive system in Rana pipiens and Amblystoma tigrinum. Albert Kuntz, St. Louis University School of Medicine.

The period of metamorphosis and the coincident period of fasting occupies approximately ten days in Rana pipiens and nine days or less in Amblystoma tigrinum. Quantitative data at hand indicates the following changes during metamorphosis.

	R. PIPIENS	A. TIGRINUM
	per cent	*per cent*
Average reduction in total weight	57.3	28.7
Average reduction in length of stomach and intestine	82.2	45.8
Average reduction in length of stomach	54.5	54.8
Average reduction in weight of stomach and intestine with contents	92.8	68.6
Average reduction in weight of liver	80	None

The more important histological changes in the stomach and intestine during metamorphosis consist in increasing thickness of the several layers and more compact aggregation of the tissue elements as the reduction in the length of the digestive tube takes place. The increase in the thickness of the several layers does not involve active cell proliferation, but is accomplished by rearrangement and aggregation of the elements already present. These histological findings agree essentially with those of Ratner ('91) in Rana temporaria.

2. The skull of Syngnathus fuscus. JAMES E. KINDRED, Western Reserve University.

In an earlier paper the primary stages in the development of the skull of Syngnathus fuscus were discussed and certain fundamental characters of importance were described and commented upon. That study has been followed by a comparative study of the ossification processes leading to the formation of the adult skull. The material has been described with reference to the modifications which the skull of Syngnathus shows when compared with a closely allied form as Gasterosteus. In its development, the skull of Syngnathus fuscus (pipe-fish) shows certain important differences from the skulls of related forms. The elongate condition characteristic of the skull of the adult fish is arrived at very early in life through the precocious growth of the ethmoid and symplectic cartilages. As a result of this the mandibular apparatus has been carried to the end of the snout and a series of bones developed for the support of the walls of the oral tube. These bones are arranged in such a manner that they form a flexible wall for the tube. They have been homologized with the suborbitals and nasal bones of closely allied species, but in this study I have regarded them as independent elements which are developed in response to local needs and not as modifications of the above bones of other teleosts. Various modifications from ordinary teleostean type of skull have been observed and a detailed description and comparison of the components of the skull has been made and the points wherein this fish is primitive or specialized have been discussed.

3. The thyroid glands of perennibranchiate amphibians. W. W. SWINGLE, Yale University.

The thyroid glands of Necturus are situated beneath the mylohyoid muscle, at the apex of the triangle formed by the geniohyoid and external cerato-hyoid

muscle. The glands are quite small but are perfectly formed and contain much colloid. In some animals the glands vary in size and location, the vesicles may be few in number but very large. Through the courtesy of Prof. Stejneger of the United States National Museum a specimen of Typhlomolge rathbuni was obtained. The animal had been preserved in alcohol for eighteen years. The thyroids could not be located, though vesicular structures filled with fluid and resembling the glands were first mistaken for them. Further investigation of two additional specimens of Typhlomolge failed to reveal glandular tissue. The thyroid apparatus of Proteus has been described by Franz Leydig, 1853 (Anatomisch-physiologische Untersuchungen über Fische und Reptilien, p. 62), and appears not to differ from the condition described for Necturus. The thyroids of tadpoles with extraordinarily prolonged larval lives, such as R. clamata and R. catesbeiana have a meager blood supply compared with adult urodeles such as Diemyctylus, Amblystoma, and oddly enough, Axolotl.

4. On the muscular system of Ornithodorus moubata, Murray. E. Melville Du Porte, Macdonald College, McGill University.

1. A descriptive study of the musculature of this argasid tick. 2. The introduction of a nomenclature similar to that in use by insect anatomists. 3. An attempt to work out the homologies of the muscles.

5. On the structure and development of a fat body or gland in the rat. J. A. Long, University of California.

This body hitherto undescribed for the rat is of considerable size and is lobed or branched. The main portion, somewhat butterfly-shaped in dorsal aspect, lies in a depression of the muscles in the middorsal line between the shoulder-blades. Continuous with the central part or separated from it only by very short spaces are other plate-like parts extending laterally between the layers of muscles. Some run well down between the deep muscles under the scapulae. It is well supplied with blood and is closely associated with vessels going to the body muscles. It is unlike ordinary body fat in color and structure, being brown to salmon colored, and being composed of cells gorged with droplets of lipoid of varying size, among which the spherical nucleus is embedded. The lipoid is a neutral fat, staining red in nile-blue-sulphate. This body is first visible in the embryo of seventeen days, after muscle formation has already begun. It increases so rapidly in size that by the end of pregnancy it is not much less in volume than the liver. The general form and arrangement of the various parts is substantially as in the adult. One detached portion extends as far ventrally as the submaxillary salivary gland. It is very highly vascular; each cell has a spherical nucleus and most cells contain one to several lipoid globules of variable size; the whole structure reminding one of an organ of internal secretion such as a corpus luteum.

6. Relation of growth to metamorphosis in the lungless salamander, Eurycea bislineata. Inez Whipple Wilder, Smith College.

For uniformity the material used has been taken from one locality. Hatching occurs during late June and early July. Metamorphic individuals are found throughout the year and range from 42 to 76 mm. in length and from 390 to 1085 mg. in weight. Total length frequency graphs based on representative collections at frequent intervals for seven years involving over 2000 individuals show, 1) large variability in different years; 2) an average length of larval life of two years with a range from one to three years; 3) segregation during the first year into a lagging and a precocious group. Experimental study of growth and metamorphosis under laboratory conditions simulating normal food and temperature conditions show, in addition to corroboration of the above conclusions, 1) successive periods of slow and rapid growth; 2) wide variation, in which sex is not the main factor, in growth and metamorphosis of individuals of the same age under the same food and temperature conditions; 3) possibility of prolonging, through the variation of food and temperature, any of the four developmental periods, postembryonic, typical larval, premetamorphic, and metamorphic. Normal tables of total lengths, tail length indices, weights, weight indices, and developmental stages have been constructed based on representative collections approximately uniformly distributed throughout five years. An exact knowledge of the normal range of variation in rate of growth and development of any species seems absolutely necessary as a basis for correct interpretation of the results of any experimental work on the ductless glands.

7. Degeneration in the pelvis of the female pocket-gopher, Geomys bursarius. Frederick L. Hisaw (introduced by J. E. Ackert), Kansas State Agricultural College.

An examination of over three hundred pocket-gophers collected in the vicinity of Manhattan, Kansas, showed that in the mature animals the pelvic bones are completely ossified and meet to form the pubic symphysis. In both males and females the pelvic girdles are greatly reduced in size. This reduction is obviously an adaptation to their fossorial habit, but, as a result, the puboischiatic-vacuity is too small for the birth of young. However, during the breeding season, a degeneration of the pelvic bones of the young female begins in the pubic region, and continues laterally almost to the obturator foramen. After the birth of young, the symphysis is not reformed, and virgins and old females can be distinguished in this way. Females with abnormal reproductive systems, due to abnormal development or to unnatural confinement in cages, retain the closed symphysis. The degeneration in the pelvis seems to be due to internal secretions of the reproductive system, either before or during pregnancy.

E. ECOLOGY AND ZOOGEOGRAPHY

1. Chemical composition of some fresh-water organisms. C. Juday, University of Wisconsin and Wisconsin Geological and Natural History Survey.

A number of fresh-water organisms have been subjected to chemical analysis in order to obtain some idea of their food value. The plants included several species of algae and a few of the large aquatics. The animals were represented

by several species of plankton crustacea, crayfish, worms, leeches, insects and insect larvae. Crude protein constituted more than 50 per cent of the dry weight of the plankton algae, but it fell to 10 per cent to 20 per cent in the large aquatic plants. In the animals the crude protein constituted from 36 per cent to 64 per cent of the dry weight of the plankton crustacea and from 35 per cent to 69 per cent in the larger forms, the maximum percentage being noted in the leeches.

The various samples of plant material yielded relatively small percentages of ether extract, only two slightly exceeding 5 per cent, except the diatoms which gave a little more than 13 per cent. The plankton crustacea yielded from 3 per cent to approximately 40 per cent of ether extract, and the larger animals from 3 per cent to 37 per cent. The plant material contained from 2 per cent to more than 10 per cent of pentosans, but all of the animal samples gave less than 2 per cent except a cladoceran, Holopedium, which yielded more than 6 per cent. In the plankton algae the ash constituted from 4 per cent to 8 per cent of the dry weight except in the diatoms where it was approximately 40 per cent; the ash amounted to about 25 per cent in the large aquatic plants. In the plankton crustacea the ash varied from about 4 per cent to almost 26 per cent, while in the larger animals it ranged from about 2 per cent in the gyrinids to nearly 35 per cent in the crayfish.

2. Some adaptations of mayfly nymphs to swift streams. (Lantern.) G. S. Dodds and F. L. Hisaw, West Virginia University.

Animals inhabiting standing water have the problem of locomotion in search and pursuit of food and flight from enemies. At will they may rest, floating in the water or resting upon the bottom. In swiftly flowing water there is no opportunity for rest—the problem of retention of position is a continuous one. Many groups of animals have invaded swift streams and successfully met its problems. Fifteen species of mayfly nymphs from ponds and streams in mountains of Colorado well illustrate modes of adaptation to such conditions. The following ways of meeting the difficult problem of retention of position in rapidly flowing water have been observed. 1) Swimming species of fish-like (stream line) form swim well in still water and the stronger swimmers invade the less swift portions of streams. 2) Species of fish-like form of small size have developed strong legs with which they cling to rocks in the swiftest parts of torrential streams. 3) Flattened forms retain position by: *a*) avoiding direct shock of water; *b*) flattening of head and legs in such an attitude that the force of the water presses the animal against the substratum; *c*) development of sucking organs from gills or ventral surface of abdomen; *d*) development of strong legs; *e*) avoiding current in crevices.

3. Some physical factors related to the distribution of littoral invertebrates. W. C. Allee, University of Chicago.

In addition to considering the direct effects of types of bottoms, shores, plants, and currents, this study deals with the possible correlation of salinity, PH, oxygen content and temperature with the distribution of associations of littoral invertebrates in the Woods Hole region. Two series of associations were studied: those of the flats and those of the rocks. In both the salinity regularly increased as one approached open water. Salinity served as a limiting factor particularly in

the associations placed well back on the flats. Next to salinity the pH of the water varies more regularly with the associations than any other factor examined. Temperature and oxygen did not vary so directly. Temperature serves as a limiting factor in low-tide pools and on the exposed flats; free oxygen vanishes from regions with muck bottom and its absence affects distribution in these places. An index figure based on a combination of these four characteristics is found to vary directly with the associations as one passes from open water. Great caution should be used in stressing any one environmental factor in ecological studies. If, on account of lack of time, it becomes necessary to resort to a single environmental factor index in the study of the distribution of animal associations of the seashore, the character of the bottom, the most obvious and longest-used index, is still the least treacherous.

4. Ecology of parasites of lake fishes. A. S. Pearse, University of Wisconsin.

Statistical studies of fish parasites were made in five Wisconsin lakes: Pepin, Geneva, Green, Mendota, Michigan. The following factors appear to increase parasitism in fishes: wide range and variety of habitats, great variety of food, vegetation, shallow water. According to their degree of parasitic infection the fishes studied in two or more lakes rank as follows: dogfish, smallmouth black bass, white bass, rock bass, pumpkinseed, sucker, black bullhead, bluegill, ciscoes, largemouth black bass, pickerel, carp, buffalo, log perch, blunt-nosed minnow, top-minnow, yellow perch, shiner (Notropis heterodon), johnny darter, black crappie, shiner (N. atherinoides), bream, shiner (N. hudsonius).

5. The eggs of the frogs, tree frogs and toads of Okefinokee Swamp, Georgia. A. H. Wright, Cornell University.

In the interior of the Okefinokee Swamp are eleven species of Salientia, and on its edges are seven other species. Those within are Rana clamitans, R. grylio, R. sphenocephala, Bufo quercicus, B. terrestris, Hyla cinerea, H. femoralis, H. gratiosa, Acris gryllus, Pseudacris ocularis, and Gastrophryne carolinensis. Those outside are Rana aesopus, R. catesbeiana, R. virgatipes, Hyla aquirella, H. versicolor, Pseudacris sp., and Scaphiopus holbrookii.

The eggs of R. catesbeiana, R. clamitans, R. grylio, Hyla cinerea, H. femoralis, H. versicolor, and Gastrophryne carolinensis float on the surface of the water; the eggs of Hyla gratiosa, Acris gryllus, and Pseudacris ocularis are laid singly on the various bottoms of the swamp; the eggs of Bufo terrestris, like those of B. americanus, are in a single file, not double as in B. fowleri, while those of B. quercicus are isolated single files of five to seven eggs or with several such files about one focus. The eggs of Scaphiopus holbrookiiin era in bands and those of R. sphenocephala are in a plinth mass like R. pipiens. The eggs of Rana aesopus, R. virgatipes, Hyla squirella, and Pseudacris sp. are not sufficiently identified to allow of positive statement. Eggs laid in captivity by pairs captured at night check the identifications of fourteen species. The first species to breed begin in February or March and each species after it has begun continues oviposition after each rainy spell until September or possibly later.

6. Further studies on the circulation of water in the Bay of Fundy and the Gulf of Maine. James W. Mavor, Union College.

Further studies with drift bottles and hydrographic measurements have confirmed the circulation of water as previously worked out.

7. The effect of temperature in limiting the geographical range of invertebrates of the Woods Hole littoral. W. C. Allee, University of Chicago.

An analysis of the geographical distribution of 241 species taken in collecting operations in the Woods Hole littoral in the last nine summers shows that 55 per cent are south-ranging and 30 per cent are north-ranging species. 40 per cent of the species are not recorded from north of Cape Cod, while 11 per cent are unknown south of the Woods Hole region. This means that the Woods Hole region is located near the northern end of a south-ranging fauna. The winter temperatures of the last four years display marked variation. Those of 1917–18 and 1919–20 were unusually severe, while the alternate years of 1918–19 and 1920–21 were unusually mild. The effect of this variation in winter temperatures on animal distribution should be most marked near the limits of distribution. The unusually cold winter of 1917–18 caused 38 per cent of all the south-ranging species to be present in noticeably fewer numbers the following summer. Of the south-ranging species whose recorded northern limit is Cape Cod, 48 per cent were affected. The similarly cold winter of 1919–20 was followed by an increase of north-ranging forms. The southern extension of north-ranging species is limited by the high summer temperatures of the flats, just as in shallow water the extreme winter cold limits the northward extension of south-ranging species.

8. Hydrogen-ion concentration of Chesapeake Bay water. R. P. Cowles and A. M. Schwitalla, S. J. (introduced by S. O Mast), The Johns Hopkins University.

During the early part of June, 1921, while engaged in a biological and hydrographic survey of Chesapeake Bay for the U. S. Bureau of Fisheries, an attempt was made to determine the hydrogen-ion concentration of the bay water in order to see if it bore any constant relation to the distribution of plankton and living organisms in general. One of the stations selected was a 'deep hole' (40.2 meters) a short distance north of the mouth of the Potomac River, where water samples were taken at one and a half hour intervals for twenty-four hours. By colorimetric methods it was found that there was a decrease in the pH value passing from the surface downward; in other words, that the water became more acid. In general a diurnal change in the pH values at all depths was evident; these values as a rule decreasing during the later part of the night and the early morning when chlorophyll-bearing plants no longer carry on photosynthesis. These observations support the results of McClendon for the sea-water at Tortugas and are confirmed in a general way by observations at another twenty-four hour station. Tidal changes were recorded by means of a current meter at all depths almost simultaneously with the pH observations and there seemed to be a tendency towards a rise in pH value when the tides turned in the daytime.

9. Canuella canadensis and other Canadian copepod records. A. Willey (introduced by A. G. Huntsman), McGill University.

The paper contains the results of the author's observations on the subjects indicated during a number of years, including notes on distribution and ecology.

F. GENERAL ZOÖLOGY

1. Note on the rate of growth of teredo and xylotrya. (Lantern.) Thurlow C. Nelson, Rutgers College and the New Jersey State Board of Shellfisheries.

A platform of dry cypress slats covered with oyster shells was submerged in Barnegat Bay, July 3, 1921, was removed to tidal creek July 25th, and on August 15th collapsed owing to heavy invasion of Teredo navalis and Xylotrya fimbriata. Slats 2×1 inch contained in cross-section 1 cm. wide, 77 Teredo and 3 Xylotrya. Average size of Teredo: length 15.5 mm., width of body, 2 mm., width at shells, 2.5 mm. Average for Xylotrya: length 29 mm., width of body 3.2 mm., width at shells, 4 mm. Maximum number of segments in pallets 14; minimum 5. Upper Barnegat Bay is rarely troubled with 'shipworms.' Abnormal salinity of water resulting from reduced rainfall; water of high salinity creeping up the bay along bottom. Densities of 10082 at surface with 10170 at bottom, 6 ft., were observed. Average density at bottom by platform in bay; 10145, maximum 10170, minimum 10125. Average temperature 25.4°C., maximum 26.6°C., minimum 24.5°C. Average density at surface during same period; 10111, maximum 10117, minimum 10105. During period in creek maximum density 10125, minimum 1009; maximum temperature 30.5°C., minimum 21°C. Ripe eggs present in both species, growth and development must have occurred in less than six weeks.

2. Observations on sex in the top-minnow, Gambusia affinis. S. W. Geiser (introduced by S. O. Mast), Johns Hopkins University.

Field collections of Gambusia and of other viviparous poeciliid teleosts almost invariably show a great preponderance of females. Experiments with litters of Gambusia raised in aquaria, with low mortality-rates, show the proportions of the sexes at birth to be approximately equal. The adult males have a higher death-rate than the females, thus producing a minority of males in adult populations. The gonads of the sexes at birth are indistinguishable from each other. They differentiate at ages of three weeks to over a year, depending upon environmental conditions. Temperature and food largely determine the rate of development. In my experimental litters, all gonads were differentiated in less than four weeks, so that ascertainment of sex was possible. Cytological study shows a fairly close correspondence between the degrees of differentiation and of the development of the anal fin (in the male) into an 'intromittent' or copulatory organ (gonopod). With favorable environment, the gonopod is developed in 95 per cent of the individuals within the first three months, but this development may be delayed till the fish is over a year old. The males in early stages (first 1½ to 2 months) grow in length and weight faster than the females. Total length in both sexes is trebled to quadrupled in the first three months. Females born in May/June bear their first litters of young when 8 to 10 weeks old. The chromosomes in soma and germ-cells are exceedingly small. Their spermatogonial number appears to be 36.

G. PROTOZOÖLOGY

1. Trophic and reproductive chromatin in the ciliate infuseria compared with similar conditions in other protozoa. M. M. METCALF.

Euciliata have a trophic macronucleus and a genetic micronucleus. The Protociliata have in each nucleus a double series of chromosomes, one set genetic, the other trophic. In the Plasmodroma we often find two sets of chromosomes, one set introcentrosomal (genetic?), the other set extra-centrosomal (trophic?). Illustration and discussion of these conditions.

2. Some effects of conjugation in the life-history of Spathidium spathula. LORANDE LOSS WOODRUFF and HOPE SPENCER, Yale University.

A study has been made of about sixty lines of exconjugants, all derived from a pedigree culture of Spathidium and bred under identical cultural conditions. A comparison of the division rate and longevity of the parent lines and their exconjugant lines gave the following chief results. 1) A large majority of the exconjugant lines exhibited a higher division rate than their parent lines. 2) A large majority of the exconjugant lines continued to live after the death of the parent lines. 3) From the original parent cell to the F_6 generation there have been nearly 1000 cell divisions, punctuated at the 30th, 134th, 425th, 573rd, 644th, and 904th divisions by fertilization. The survival value of conjugation is indicated by the fact that the parent, F_1, F_2, F_3, F_4, and F_5 generations have died in turn—the pedigree culture now existing in the F_6 generation.

H. PARASITOLOGY

1. The parasitic Protozoa of Blatta orientalis and their value as the material for use in a class of parasitic Protozoa. R. KUDO, University of Illinois.

One of the difficulties connected with the study of parasitic Protozoa lies in the collection of host animals. Artificial infection and cultivation of parasitic Protozoa have only been done in a comparatively few cases. At present one must obtain a great majority of parasitic Protozoa from their natural sources—the host animals. The occurrence of parasitic Protozoa is highly uncertain. Ordinarily a host species does not harbor many species of Protozoa and the per cent of infection is usually small under natural conditions. For their study, especially in a class-room, one has to collect many individuals of the host animals. The material desirable for a class work should at least fill the following conditions: *a*) the host animal should harbor Protozoa of variety and large dimensions; *b*) the per cent of infection should be high; *c*) the host animal should easily be collected and kept alive in the laboratory; *d*) the host animal should be of convenient size. After comparative studies of various animals as the host, I came to the conclusion that Blatta orientalis is so far best fitted for the purpose and recommend it as the material for class work. The insects examined by me at Urbana, Illinois, harbored the following species of Protozoa: Endamoeba blattae, Lophomonas blattarum, L. striata, Coelosporidium periplanetae, Gregarina blattarum, Nyctotherus ovalis. The papers of pioneer Protozoologists (Stein, Bütschli, Leidy, etc.) and of modern workers (Janicki, Mercier, etc.) upon these Protozoa will be reviewed elsewhere with my own observations upon them.

2. A preliminary report on the activities of infective hookworm larvae in the soil. William W. Cort and Donald L. Augustine, Johns Hopkins University.

Little is known of the activities of infective hookworm larvae in their natural environment on account of the difficulty of studying them in the soil. An apparatus invented by Baermann, which has made it possible to isolate hookworm larvae from considerable quantities of soil, was used in investigations, which were carried on during the past summer in Trinidad, British West Indies. It was found that a large percentage of infective hookworm larvae isolated from soil samples taken in the field and from laboratory experiments had lost their protective sheaths, indicating that it is a very common thing for them to complete their second moult in the soil and to continue to live unsheathed. Both field studies and laboratory experiments showed that hookworm larvae do not migrate to any extent in the soil, so that soil infestation is practically limited to the places of development. It was also learned that the life of the infective hookworm larvae in the soil is much shorter than is usually supposed. In less than six weeks after the elimination of soil pollution from a cane field, the hookworm larvae present in the soil had almost died out. A series of laboratory experiments showed the same shortness of life even under the most favorable conditions. In these experiments even in three weeks there would be a considerable reduction in numbers and almost none of the larvae survived after six weeks.

3. Notes on North American blood flukes. G. A. MacCallum, Baltimore.

These interesting trematodes are comparatively new to science. Probably the first found in America were on January 4, 1912, when I found three small worms in the washings of the intestines of a Chelopus insculptus and which I named Spirorchis, but carelessly omitted the specific name which I intended to be eustroptos, both names meaning twisted or spiral, referring to the testis. Again on January 4, 1917, several more of the same were found, and shortly after a species was found in the intestines of Chrysemys picta, and these were named S. pictae, and what seemed odd some of S. eustreptos were also found in the intestines of Chrysemys picta, apparently the same worms as those found in Chelopus insculptus. Again on August 4, 1921, a specimen was taken from the lung of Emys blandingii quite different but of the same genus shown in Zoopathologica, vol. 1 no. 6. It is somewhat imperfect, but recognizable. Then on July 17, 1921, I found within the heart of a Chelydra serpentina (western form) five Spirorchidae which were attached to the wall of the ventricle, but all coiled together as if in coition. These worms were the largest of any Spirorchidae I had seen, being in length 8.50 to 9 mm. × 1 mm. wide, and which I have named S. chelydrae. The peculiarity about these worms is the much bent oesophagus, also the numerous glands at the junction of the oesophagus and coeca and possibly posterior also on the outside of the oesophagus to the mouth. These glands probably secrete a sort of hirudin which acts as an anticoagulant for their food.

4. A study of diphylobothrium ova. Meyer Wigdor.

Magath ('19), on the basis of the measurements of 100 ova of *D. latum* and on a peculiar minute thickening of the shell at the pole opposite to the operculum, states: "With these characteristics, which are purely morphologic, one may make a very definite diagnosis of the presence of this worm, the egg lying within the

range of size given above." Measurements of 25 eggs of D. latum, D. fuscum and D. pseudocordatum, a new undescribed species, were made by me and the egg measurements of D. cordatum compared. The peculiar shell thickening described by Magath was noticeable in the three species in which eggs were available, so that this morphological feature is apparently a generic rather than a specific one. The ova of D. latum in man as given by Magath have an average ratio of length to width of 138 : 100. My measurements of the ova of D. latum and D. fuscum in the dog show ratios of 137 : 100 and 135 : 100, respectively. As far as the morphological characteristics and the size of the egg of the two species are concerned, D. latum and D. fuscum in dogs cannot be readily distinguished. The ova of D. cordatum and D. pseudocordatum are more elongated and relatively narrower than the preceding two species and can usually be differentiated from those two species if an average of several measurements is taken. There is a marked variation in the size and shape of the eggs, however, so that the largest egg of D. latum and D. fuscum can hardly be differentiated from the smallest eggs of D. pseudocardatum. Diphyllobothrium ova afford a generic, but hardly a specific differentiation.

5. *A new genus of trematodes from the white-bass.* H. J. Van Cleave, University of Illinois.

A heavy and general infestation by minute distomid trematodes was discovered in the intestine of the white bass (Roccus chrysops) from the Missippissi River during an investigation of fish parasites for the Bureau of Fisheries. These trematodes belong to a new genus to which the name Allacanthochasmus has been ascribed and for which A. varius, the only certain species, is designated as type. Distomum tenue of Linton seems to have many points of structure in common with this new genus. Individual variation is very marked in this new species. Relative position of organs such as the testes are greatly modified by the degree of contraction or extension of the body. The oral sucker is surrounded by a prominent crown of spines arranged in a complete single circle. Allacanthochasmus seems to have definite relationships with the genus Acanthochasmus of Looss and may have considerable phylogenetic significnace. Members of this genus display marked host specificity for extensive investigations of the parasites of other fishes, from the same localities where infestation of Roccus chrysops were general, failed to disclose a single instance of infestation in any species other than the type host.

6. *Apparent racial immunity to certain nematode infections.* Benjamin Schwartz and Marcos A. Tubangui, University of the Philippines.

In the course of a survey on the frequency of helminthic infections in man in the Philippine Islands that is still in progress, it has been found that while the percentage of infestation with certain common intestinal nematodes, namely, Trichuris, Ancylostoma, and Necator, is very high, the degree of infestation is extremely light. Out of 250 examinations, about 60 per cent were found to be positive for whipworm and hookworm. With very few exceptions, infestations with these nematodes, as judged by the scarcity of ova in concentrated sediments of fecal samples, were very light. The frequency of infestation with Ascaris has been found to be lower than that of whipworm and hookworm, but numerous

eggs have been found in positive fecal samples. These observations are in harmony with autopsy findings which show almost invariably light infestations with whipworm and hookworm and from moderate to heavy infestations with ascarids. Inasmuch as living conditions in the Philippines favor heavy helminthic infections, it may be concluded that Filipinos are comparatively immune to infestations with Trichuris, Ancylostoma, and Necator and that they are quite susceptible to infestations with Ascaris. Possibly an initial light infection with whipworm and hookworm establishes an immunity to further parasitization. The possible presence of such immunity in Filipinos is being investigated by serological methods.

7. *Intestinal protozoan infections as an index of personal hygiene and institutional sanitation.* William C. Boeck, University of Wyoming.

Protozoan surveys conducted in England and a similar survey in this country completed by the U. S. Public Health Service on June 30, 1921, have shown that the incidence of protozoan infections was higher among persons confined in institutions than among those leading a free existence. Confinement was in some way responsible. As a part of the latter survey, 190 patients were examined from an asylum, 108 prisoners from a northern penitentiary, 77 training school boys, and 38 industrial school boys and girls. These persons had been admitted to their respective institutions since 1915. Another series comprises 545 patients who had been confined in the asylum from 1 to 42 years. The results of these examinations were: 1) The incidence of infection was found to increase with additional years of confinement. 2) a large number of pure (single) and a smaller number of mixed (double, triple, etc.) infections occurred among persons but recently admitted to an institution, while the opposite was true among persons who had been confined for longer periods. The number of pure infections became mixed later on by the acquisition of new infections. 3) The spread of protozoan infections seemed the result of low standards of personal hygiene and institutional sanitation. Less infections were found among the prisoners than among the other institutional cases, which was attributed to the excellent standards of personal cleanliness and institutional sanitation in the prison which did not obtain to same degree in the other institutions.

8. *Ophiotaenia testudo nov. spec. from Amyda (trionyx) spinifera.* Thomas Byrd Magath, Mayo Clinic.

The description of a cestode found in the intestine of the soft-shell turtle (A. spinifera) from Lake Pepin, Lake City, Minnesota, is presented. This record is believed to be unique in the respect that no descriptions have been made in American literature of cestodes from turtles although many animals have been examined from the Mississippi River. Twenty turtles were examined, all or thirteen, whose carapaces were over 8 inches long harbored the parasite, those under 8 inches were not infected. The chief food of this turtle at Lake City is crayfish, which being the distinctive food of the soft-shell turtle suggested the crayfish as the intermediate host. Many were examined without success, as were attempts to experimentally infect them. The worm belongs to the genus Ophiataenia, but is unlike any of the described species. Length 50 cm., maximum breadth 1.6 mm. Scolex, 0.63 mm. wide and 0.42 mm. long. A median fifth

sucker is absent. The four suckers are 0.12 mm. × 0.10 mm. Genital pore irregularly alternating at the end of the anterior sixth. Cirrus pouch, 0.56 mm. × 0.27 mm.; ductus ejaculatorius is coiled and the testes (about 200) are in two lateral fields. The vaginal opening is anterior to that of the cirrus. Ovaries, alated; vitellaria extend nearly to the anterior margin of the proglottid. The arrangement of the female genital organs is essentially like that of the other members of the genus. The uterus is median and has about fifteen pouches. The gross diameter of the eggs is 0.030 mm. This paper will be published as a contribution from the United States Bureau of Fisheries Biological Station at Fairport, Iowa, and the Section on Clinical Pathology, Mayo Clinic, Rochester, Minnesota.

9. Otacariasis in the fox. Wm. A. Riley, University of Minnesota.

Ear canker is a widely distributed and serious difficulty among domesticated foxes. Unlike that of rabbits, it is not due to Psoroptes, but to a species of Otodectes. Experimental and control work will be reported.

10. A new venture in the field of practical parasitology. (Motion pictures.) B. H. Ransom, U. S. Bureau of Animal Industry.

Recent discoveries concerning the life-history of Ascaris lumbricoides, a common and highly injurious roundworm parasitic in human beings and in swine, have suggested the possibility of minimizing the losses caused by this parasite among young pigs. At present in many localities these losses are very serious, to the great detriment of the live-stock industry. During the last two years some attempts at a practical control of roundworm infection have been made by the Bureau of Animal Industry of the U. S. Department of Agriculture on a considerable number of farms in the Middle West with highly successful results.

11. The host-parasite method of investigation and some problems to which it gives approach. M. M. Metcalf.

Problems as to 1) Taxonomic relations between hosts; illustrated from Vernon Kellogg's work upon bird-lice. 2) Taxonomic relations between parasites; illustrated from Aphides. 3) Place, and time of origin and migration routes of hosts; illustrated from the genera Hyla and Bufo and their Opalinidae. 4) Place and time of origin of the parasites and their migration routes; illustrated from Zelleriella and Protoepalina. 5) Paleoclimatic conditions; illustrated from evidence from the present geographical distribution of Anura and Opalinidae, *a*) as to drougth in northern Mexico, b) as to temperature and moisture in Antarctica. 6) Conditions of forestation and moisture in the past; illustrated from Central America and South America and a study of their Hylids with their Opalinids. 7) Ancient land connections; illustrated from the Americas and evidence from fishes Amphibia and their parasites; also from Johnson's work on Australian Cestoda and Trematoda. Comprehensive, concomitant studies of host and parasite among both animals and plants is of essential importance in reconstructing paleogeography in all its phases, and is of great value from other points of view.

12. The rôle of domestic chickens and pigs in the spread of hookworm disease. JAMES E. ACKERT, Kansas State Agricultural College.

Feeding experiments with domestic chickens and pigs, conducted last summer in Trinidad, British West Indies, demonstrated that these animals act as vectors in the spread of hookworm disease. By administering hookworm eggs in human excrement to chickens, it was shown that not only do such eggs remain viable in passing through the fowls, but they produce infective hookworm larvae in a medium of chicken feces and animal charcoal or soil. However, a series of quantitative tests indicated that a majority of the hookworm eggs swallowed by chickens fail to produce infective larvae. This failure was attributed to breaking of eggs in the gizzard, injury from urine in the feces, and to malnutrition of the larvae in the excrement. On the other hand, the experiments show that chickens may bring hookworm eggs from remote places up to the drinking dishes, and thus establish infective spots frequently traversed by the barefooted civilians. Newly hatched hookworm larvae pass through the digestive tract of chickens apparently uninjured, but infective larvae administered to chickens do not pass at once from the fowls. On the whole, the domestic chicken appears to be more beneficial than harmful in the control of hookworm disease in Trinidad. Unfortunately, not so much can be said for the pig whose masticatory, digestive and excretory systems so closely resemble those of man. Results of experimental feedings indicated that the majority of hookworm eggs swallowed by pigs produced infective larvae in a culture medium of pig feces and soil.

13. A study of the resistance of different hosts to Trypanosome infections. W. H. and L. G. TALIAFERRO, Johns Hopkins University.

The resistance which an animal offers toward a trypanosome infection may be directed either toward a retardation of the rate of reproduction of the parasites or toward their actual destruction after they are formed. We have been able to distinguish between these two conditions, first, by counting the trypanosomes per unit volume of blood and, second, by ascertaining their comparative rate of reproduction as is shown by their coefficient of variation for size. The use of the coefficient of variation as a measure of the rate of reproduction is making use of the obvious fact that a rapidly reproducing population of protozoa is more variable than one in which there is little or no reproduction. Its great value lies in the fact that its determination is independent of the actual number of organisms present. Studying the problem of resistance along these lines, we have reached the following conclusions: 1) in T. lewisi in the rat, a resistance develops which both retards the rate of reproduction of the parasites and destroys them after they are formed; 2) in T. brucei, etc., in guinea-pigs and dogs, the resulting resistance leads to the destruction of the parasites after formation with no appreciable effect on the rate of reproduction, and, 3) in T. brucei, etc., in rats, no resistance on the part of the host develops either toward their rate of reproduction or their destruction after formation.

14. The anomalies in the group of blood-infesting trematodes. HORACE W. STUNKARD, New York University.

The group of blood-inhabiting trematodes at the present time comprises three families, the Schistosomatidae, the Spirorchidae, and the Aporocotylidae. The

first of these families is the best known and contains the bisexual forms parasitic in the blood vessels of birds, cattle and man. The Spirorchidae are hermaphroditic forms parasitic in the vessels of turtles, and the Aporocotylidae are also hermaphroditic occurring in the blood vessels of fishes. Probably no other trematode group presents such unusual variety and diversity, and no adequate explanation has as yet been presented for this condition. Common characteristics are found throughout the group, but within the families and even genera great morphological disparities are present. The fish parasites are without organs of adhesion, one genus of turtle parasites has only an oral sucker while the other has both acetabulum and oral sucker, and in the family Schistosomatidae there are genera without suckers and others with both ventral and oral adhesive organs. In the Aporocotylidae the genital pore is dorsal, in the Spirorchidae it is ventral and somewhat lateral, and in the Schistosomatidae it is ventral, either in the median line or to the right or left of it. Within each family there are representatives with a long coiled uterus containing many eggs, and others with a short uterine portion of the female genital duct containing a single egg. These major differences are accompanied by minor differences and constitute a large and unusual list of anomalies in the group of blood infesting trematodes.

15. Some additional results obtained in the study of infectious anemia of horses. John W. Scott, University of Wyoming.

Principal results since previous reports include: 1) Tabanus septentrionalis can transmit the disease. 2) Saline tabanid extract produces anaphylactic reaction only. 3) Some horses have a high degree of natural immunity, show no apparent symptoms, and still are carriers of highly virulent blood. 4) The course and character of the fever usually serves to distinguish horses infested with parasitic worms from chronic cases of swamp fever. 5) Blood of one carrier has been virulent over five years. 6) Experiments have proved that the virus is present in the nasal secretion, thus suggesting new possibilities in transmission. 7) In the course of the disease, the erythrocytes gradually diminish but frequently regain the normal number, the hemaglobin content remains closely proportional to the number of erythrocytes present, and the leucocytes increase at a fever period. 8) With cooperation of Dr. S. H. Burnett, it was found that the total increase of leucocytes was due, chiefly at least, to increase in polymorphonuclears and that the eosinophiles disappear or greatly decrease during a fever reaction. In cooperation with Dr. F. S. Jones, of the Rockefeller Institute, contrary to findings of the Japanese, we were unable to find spirochaetes, 1) in stained blood smears or, 2), by using dark-field illumination, in fresh citrated blood either before or after centrifuging, in fresh smears of spleen, kidney, liver, and lymph gland, or in Noguchi cultures from such organs and from the blood. 3) A very minute rod-like organism was found in some cultures, nature unknown, since inoculations so far have given negative results.

16. Sporulation and development of the cysts in a new species of Myxosporidia, Lentospora ovalis. H. S. Davis, University of Florida.

Gills of the buffalo-fishes, Ictiobus bubalus and I. cyprinella from the Mississippi River at Fairport, Iowa, are often badly infected by a new species of Myxosporidia, Lentospora ovalis. The parasites are carried to the gills in the

circulating blood as amoeboid plasmodia containing three or four nuclei. These nuclei become differentiated into two distinct types, vegetative and generative, which have very different functions. Both types multiply rapidly, the generative much faster than the vegetative. The cysts normally develop within the blood vessels, the walls of which become greatly distended. Each pansporoblast develops from a single cell, the first evidence of the formation of the definitive pansporoblast being a heteropolar division which divides the cell into two very unequal parts. The daughter cells remain closely associated after division and from them are derived all the cells of the pansporoblast. The smaller cell divides but once to form the two envelope cells which become flattened and form a thin covering for the remaining cells of the pansporoblast. Each pansporoblast forms two spores of six cells each. In late stages of the pansporoblast small deeply staining chromatoid bodies are often present. Their origin was not determined but it is not believed they are reduction nuclei since their number and size is very inconstant. No evidence was obtained of any sexual process during the development of the spores. The spores continue to develop until the cysts reach a diameter of about 500 to 700μ.

17. On the migration of the sheep lung worm, Dictyocaulus filaria. JOHN E. GUBERLET, Oklahoma Agricultural Experiment Station.

The writer ('19), in the case of Dictyocaulus filaria, has shown that infestation takes place through the mouth and that the larvae migrate to the lungs. It was thought for a time that the migration of lung-worm larvae took place as in Ascaris, as has recently been shown by Stewart ('17, '19), Ransom and Cram ('21), and Yoshida ('19). Recent experiments with dictyocaulus in which gross infectation was produced by giving numerous larvae almost daily over a period of twenty days have thrown some light on the matter. At the end of twenty days the lamb was killed and autopsied. Numerous larval worms were present in the blood. Mesenteric lymph glands, liver, spleen, and kidneys, as well as lungs, contained larval worms. The mesenteric lymph glands were much enlarged. Previously, it was observed that lung symptoms first appeared about twenty days after inoculation. In this case no symptoms appeared until the eighteenth day. Blood was occasionally drawn from the jugular vein, the last being taken on the fourteenth day, with negative results. Apparently, the larval worms do not enter the blood stream at once, but remain in other organs, very probably in the mesenteric lymph glands for some time before entering the blood which carries them to the lungs. The presence of larvae in the liver, spleen, and kidneys is undoubtedly a late development and due to the circulation. Subcutaneous inoculation with larval worms gave negative results.

18. Studies on Spirochaeta duttoni in the tissues of its invertebrate host, Ornithodorus moubata. E. MELVILLE DU PORTE, Macdonald College, McGill University.

The spirochaete was found to be still present in three races of laboratory-reared ticks brought to this country originally in 1913. Sections of the ticks show the presence of the spirochaete in most of the organs and tissues including the cephalic glands, brain, mesenteron, uterus, ova, and the connective, adipose, and muscular tissues. The eggs may become infected within the ovary or in their passage through the uterus. Eggs that escape infection within the body of

the tick may be infected after being laid since the secretion of the cephalic gland, with which they are covered, may contain large numbers of spirochaetes.

19. A little-worked source for parasite material. M. M. Metcalf.

Museum specimens of animals preserved in alcohol give workable material of many internal parasites, especially nematodes and ciliate infusoria. Formalin material is unsatisfactory. The generous attitude of the United States National Museum. The importance of using such material in many museums. It is important in collecting, that both the larger organisms and their parasites should be in mind in deciding methods of killing and preservation.

20. A coelomic coccidian of Tribolium. Wm. A. Riley and Laurence Krogh, University of Minnesota.

While Coccidia are widely distributed and numerous in species, coelomic forms have been rarely noted. Three species have been reported for insects and two for Oligochaetes. An apparently new species has been found abundantly in flour beetles belonging to the genus Tribolium. Life-history studies and infection experiments are to be reported.

21. On Leptotheca ohlmacheri, a myxosporidian parasitic in frogs. R. Kudo, University of Illinois.

About 40 per cent of Rana clamitans and R. pipiens studies were found to be infected by a myxosporidian, Leptotheca ohlmacheri. The spores had been known since Ohlmacher ('93) found them in the kidney of Bufo lentiginosus. The seat of infection is the lumen of the uriniferous tubule and the space between Bowman's capsule and the glomerulus of malpighian body of the kidney. The infection of a new host animal seems to take place per os. The spore germinates in the stomach under the influence of gastric fluid. The amoebae penetrate through the intestinal wall and pass into the coelom, hence into the uriniferous tubule or malpighian body by way of nephrostome or blood vessels. The spore contains two independent uninucleate sporoplasms which fuse into one mass at the time of germination. The nuclei seem to unite later. The young stage found in the tubules of the kidney is small uninuclate form. Schizogony in this stage seems to be of probable occurrence. The uninucleate form grows. The nucleus divides into two, one vegetative and the other generative nucleus. The former by undergoing further divisions produces trinucleate gemma which becomes separated from the mother body. The latter divides into two generative nuclei, each of which develops into a spore. The trophozoites are usually disporous. The vegetative nucleus persists throughout the entire trophic life of the trophozoite. The parasite does not seem to exercise fatal effect upon the host animal.

22. Notes on two new species of holostomidae. John E. Guberlet, Oklahoma Agricultural Experiment Station, Stillwater.

Two species of Holostomidae were found in the intestine of a loon (Gavia immer) killed near Stillwater, Oklahoma. These proved to be undescribed species belonging to two genera, Hemistomum Diesing ('50) and Strigea Abildgaard (1790). For the former the name Hemistomum gavium is proposed. This

is a small form 1 to 1.5 mm. in length. The flattened anterior region, 0.30 to 0.40 mm. in breadth and 0.094 mm. in thickness, comprises approximately two-thirds of the body length. The adhesive disk is posterior to the acetabulum, but does not cover it. The posterior cylindrical region is 0.24 to 0.28 mm. in diameter. For the species in the latter genus the name Strigea aquavis is proposed. This species is 2.5 to 3.5 mm. in length. The cup-shaped anterior region measures 0.5 to 0.75 mm. in length and 0.6 to 0.9 mm. in diameter. This region contains the oral sucker, acetabulum, and adhesive disk, or hold-fast organ. The oral sucker and acetabulum are approximately of equal size. The hold-fast organ is composed of leaf-like structures which protrude anteriorly. The cylindrical posterior region, 0.45 to 0.55 mm. in diameter, contains the reproductive organs. Heretofore, only one North American species of Hemistomum has been recorded, that being Hemistomum craterum Barker and Noll ('15), from Fiber zibethicus. The only species of the genus Strigea previously reported from North America is Strigea cornu Rud., from Ardea herodias by Stiles and Hassall ('94).

I. COMPARATIVE AND GENERAL PHYSIOLOGY.

1. Mutual reactions of cell-bodies and pseudopodial fragments of Difflugia. Wm. A. Kepner and B. D. Reynolds, University of Virginia.

1. In Difflugia we have non-nucleated ectoplasmic fragments fusing with the parent cell, resulting in restitution. 2. The parent cell and ectoplasmic fragment are guided to each other by some chemical means other than carbon dioxide, or urea. 3. Fusion never occurs at the ends of the parental pseudopod, but is always effected along an extended midregion; therefore, there must be a difference between the ends and the middle of such pseudopods. 4. The response between a severed fragment and the parental cell is mutual, the direction of approach being shifted to correspond to the changing positions of the protoplasms involved. Movement on the part of an enucleated ectoplasmic fragment seems to be more than aimless. 5. All mutual reactions between protoplasmic fragments and cells were found to be individual rather than specific. Our observations indicated that if an individual protoplasm be separated there would be a tendency to restitution of the whole; but even though one cell be deprived of a part of its body, if protoplasm of another species, or from another individual of the same species, be placed in proximity to it, there will be no response. Thus it is emphasized that after all there is something peculiar in the individual's make up. This peculiarity may be due to the allotment of germ-plasm assigned to the individual at cell division, or to the changes wrought by the flux of the life of the individual since separation from its parent, or both.

2. Reactions to light of the earthworm, Lumbricus terrestris. Walter N. Hess, DePauw University.

Earthworms, which are negative to light of ordinary intensities, become positive, in keeping with their nocturnal habits, when the light is greatly diminished. If, however, the brain is removed either by a dorsal incision or by the removal of the first three anterior segments, they no longer react negatively to ordinary illumination, but become strongly positive, and if six or even more of the anterior segments are removed, they are still positive. Similar results were obtained with

Allolobophora foetida with as many as forty anterior segments removed. These results show that the brain of the earthworm is not necessary for reactions to light and photic orientation. They indicate that earthworms are more sensitive to light when the brain and the photoreceptors at the anterior end are functional, than they are when they are not functional. This accounts for the fact that, while normal worms are positive only in very weak light, specimens with the brain removed are positive in strong light.

3. The rate of metabolism of Paramecium with controlled bacterial food supply. Geo. T. Hargitt and Ruth L. Phillips, Syracuse University.

It is easy to sterilize Paramecium so that no bacteria remain adhering to its body, and by using ordinary bacteriological technic it is also feasible to control the bacterial content of a culture fluid. The two methods combined enable one to control the food of Paramecium experimentally, as rigidly as desired. The rate of metabolism of Paramecium has been tested under these conditions of controlled bacterial food. The bacteria used were taken from ordinary hay infusions and used either in pure cultures or as mixtures of 2 or 3 kinds. All experiments were checked by the metabolic rate of Paramecium fed on the usual unknown bacterial mixture of the hay infusion. Some of the experiments covered only a few days or weeks, others extended over a period of six months, and two were observed for nine months.

In general the highest rate of metabolism seems to occur in such complex mixtures of bacteria as are found in hay infusions. The single pure culture of bacteria which was successful gave a low rate of metabolism for Paramecium, but the rate was fairly uniform. Mixtures of bacteria gave excellent results with a rather high rate of metabolism, though usually not so high as with the more complex mixtures of the hay infusion. Tests were also conducted upon the effect of changing the bacterial food from time to time. It was concluded that if the food was satisfactory at first a continuance of this food gave higher and more constant rates of metabolism than a change of food.

4. The feeding reactions of Amblystoma tigrinum (Green). Albert Kuntz and José Zozaya, St. Louis University School of Medicine.

This paper comprises the results of experimental work carried out at the Macbride Lakeside Laboratory during the summer of 1920 which may be summarized as follows: The typical response of the larvae of Amblystoma tigrinum to the presence of food consists of an 'approaching' and a 'seizing' reaction. Young adults frequently exhibit also a 'nosing' reaction. The 'approaching' reaction is commonly a visual response. The 'nosing' and 'seizing' reactions, except when the latter follows the 'approaching' reaction more or less spontaneously, involve the olfactory sense. Moving objects are detected and pursued more promptly than objects which are not in motion. In the absence of sight food is detected by the sense of smell. Discrimination between edible and inedible objects also involves the olfactory sense.

5. The rôle of the nervous system in the locomotion and regeneration of marine polyclads. J. M. D. Olmsted, University of Toronto.

The locomotion of polyclads is comparable with that of gastropods. Ataxic locomotion is a local phenomenon, but controlled by the nervous system since

it is abolished by chloretone. Certain species progress only by this method. Ditaxic retrograde locomotion is under the control of the cephalic ganglia, each ganglion governing the progression of muscular waves on its own side. The nerve cords serve as conductors for impulses leading to wave formation each on its own side. Cutting one nerve causes the waves to disappear on that side at the level of the cut. Ciliary action is not under the control of the nervous system and plays practically no part in locomotion. For the swimming movement it is necessary that the cephalic ganglia be intact. Injury to or loss of the brain prevents the animal from employing this method of locomotion. Polyclads are able to restore missing parts provided the cephalic ganglia are intact. If these are injured nervous tissue is not added to restore the brain to its original size, and if they are entirely removed regeneration can not take place anteriorly, though it may do so posteriorly. If a portion of the brain remains, a certain amount of anterior regeneration takes place and eyes are regenerated, but not enough material is added to restore the original form, and the new eyes never reach the size of the old ones.

6. *A quantitative study of tarsal sensitivity to solutions of saccharose in the Red Admiral butterfly, Pyrameis Atalanta (linn).* Dwight E. Minnich, University of Minnesota.

The author has previously shown that the tarsi of the red admiral butterfly, Pyrameis atalanta (Linn), are sensitive to contact chemical stimulation. One substance sharply distinguished through the tarsi is a M solution of saccharose. If the tarsi are brought in contact with this solution Pyrameis always responds by extending the proboscis, irrespective of its nutritional condition. The animal may also respond if the tarsi are brought in contact with distilled water, but only after a more or less prolonged period of total inanition. Moreover, the administration of water immediately inhibits the response. It is possible, therefore, to maintain Pyrameis in a state of 100 per cent responsiveness to M saccharose, but of 0 per cent responsiveness to water alone. Under these conditions the minimal concentration of saccharose necessary to effect a response, i.e., the threshold concentration, is readily determined. Seven butterflies were intensively studied under varying nutritional conditions. The results show that the threshold of response to saccharose varies directly with the nutritional condition. During periods of inanition with respect to saccharose the threshold gradually falls, and may reach such levels as M/3200, M/6400, or even M/12,800. But with the initiation of a period of saccharose diet, the threshold rises abruptly to a level usually of about M/10, where it remains approximately constant as long as the diet continues. Compared with other animals, the sensitivity to saccharose in Pyrameis is very highly developed. This is doubtless correlated with the fact that sugars form the chief food of this insect.

7. *A micro-Winkler method for quantitative determination of dissolved oxygen.* E. J. Lund, University of Minnesota.

It has been found possible and entirely practicable to determine dissolved oxygen in quantities of water of 10 cc. or even less by employing 0.1 cc. each of the solutions KI-NAOH, and $MnCl_2$ ordinarily used in the Winkler method, instead of 1 cc. of each of these solutions. The thiosulphate solution of the

usual concentration is diluted ten times or even more if necessary. Addition of the reagents is best accomplished from micro-burettes, drawn to long capillary points. Titration in a small, deep dish is carried out with a burette reading to 1/20 cc. Loss of iodine is proportionately not greater than in the usual method. The limit of error is about 0.005 cc. or 0.007 of a milligram of oxygen gas. This procedure represents, therefore, by far the most delicate method ever devised for the quantitative determination of oxygen. Special procedures are used to remove protozoa, small pieces of tissue, etc., from the water before analysis. A full account of the methods will appear in the publications of the Puget Sound Marine Biological Station.

8. A contribution to the colloid chemistry of protoplasm. L. V. Heilbrunn, University of Michigan.

Recent work on colloid chemistry has shown that the electric charge on the particles of colloidal solutions is of especial importance. Primarily it is this charge that keeps the colloidal particles dispersed through the liquid that contains them. Some colloidal solutions are positively charged, others negatively. It is essential to determine whether protoplasm is a positive or negative colloid. This can be done by an indirect method. Sea-urchin eggs were placed in isotonic solutions of various salts and then after varying intervals of time the protoplasmic viscosity was compared. Calcium chloride tends to liquefy the protoplasm, magnesium chloride also acts in this way, although less strongly; on the other hand, potassium, sodium, and ammonium chloride tend to precipitate protoplasm and their effect increases in the order named. The results indicate that protoplasm is positively charged. But the surface layer is negatively charged, for the very salts which coagulate the protoplasm cause the plasma membrane to swell, and those that liquefy the protoplasm tend to prevent this swelling. The results not only furnish evidence as to the charge on the colloidal particles of protoplasm, but they also provide an easy and rational explanation of the phenomena of antagonism.

9. Transplantation of the pars nervosa of the pituitary. W. W. Swingle, Yale University.

Subcutaneous homoplastic and heteroplastic transplantation of the pars nervosa of adult R. clamata and R. catesbeiana into larvae cause shrinkage and emaciation after twelve hours. Control grafts of the pars anterior and brain tissue show no such effect. The larvae vary in their reaction to the graft, but in none does the shrinkage persist following resorbtion of the implanted tissue. The experiments indicate that the shrinkage and emaciation of the tadpoles are due to the well-known diuretic action of pars nervosa secretion, and not to muscular contraction. In frog larvae the activity of the mesonephros is intimately associated with maintenance of normal body appearance. Tadpoles constantly absorb water through the skin, circulate it through the lymph and blood system finally eliminating it by means of the mesonephros. A continual stream of water passes through the organism; the tissues, body cavity and lymph sinuses are turgid, and it is owing to this fact that under normal conditions the tadpole body has a round oedematous appearance. Processes of absorption and elimination are in equilibrium, but any block in the kidney function or undue

stimulation of renal activity overthrows the equilibrium and the appearance of the larva changes. Blocking the kidney function leads to rapid and fatal oedema; transplanting the pars nervosa, the secretion of which apparently acts upon the larval mesonephros as it does on the mammalian metanephros by stimulating the secretory cells to greater activity, leads to shrinkage and emaciation owing to loss of turgor through increased elimination of water.

10. Photic orientation in the robber-fly, Proctacanthus. S. O. Mast, The Johns Hopkins University.

Specimens with middle and front legs on one side removed orient fairly accurately.

If the upper surface of one eye and the lower surface of the other are covered the insects, if properly illuminated, lean toward the former and turn toward the latter. If one eye is covered and the illumination is confined to a small portion of the other, the legs on both sides respond in such a way as to tend to cause the animal to turn toward the illuminated surface, no matter where it is located. If the illumination is confined to a certain portion of the anterior surface the insect goes fairly directly toward the light, although only one eye receives light. In light from two sources of unequal intensity the two eyes are also unequally illuminated when the insects are oriented.

The turning effect of the illumination of a given region of the retina on one side is neutralized by equal illumination of the same region of the retina on the opposite side or by lower illumination of regions relatively farther back.

These facts and others prove conclusively that the tonus hypothesis, or any other that demands balanced action in receptors and locomotor appendages on opposite sides, does not fully account for orientation in *Proctacanthus*. They show that it is dependent upon series of coordinated reflexes in the legs on both sides specifically related to the localization of the stimulus in either eye and inhibition of the effect of illumination in one eye by simultaneous illumination in the other.

11. Light and growth in animals. A. G. Huntsman and F. Fraser, University of Toronto.

The growth of the mussel (Mytilus edulis) was found to be greatly impeded by exposure to full sunlight. This effect was shown to a greater degree in the antero-posterior and the dorsoventral than in the transverse axis or than in the weight of dry material. A comparison has been made of growth in full direct sunlight with that in direct sunlight diminished to about one-eighth. The rock barnacle (Balanus balanoides) shows nearly twice as much increase with the lower illumination. Colonies of Clava leptostyla show more than twice as great an increase in the number of zooids with the lower illumination.

12. 'Reversal of inhibition' in insects by atropine. W. J. Crozier, Rutgers College.

Representatives of a number of invertebrate phyla have been found to show under influence of strychnine a special excitation of extensor neuromuscular elements, such that there appear phenomena of opisthotonus and of reversal of inhibition. With insects strychnine is singularly ineffective in these respects,

and is of very slight toxicity. Sphingid and other large caterpillars, however, do show pronounced neuromuscular 'reversals' in connection with the antagonistic muscles controlling movements of the prolegs, but only when atropine has been injected; none of a series of neuropile substances, save atropine, acts in this manner. Annelids do suffer differential neuronic excitation under strychnine, as can be demonstrated very completely in leeches. With crayfish, strychnine is very slightly toxic, but does stimulate certain neuromuscular groups (leading to forward progression), and may produce opisthotonus. These facts point to chemical peculiarities of the insect nervous system, differentiating it from that of groups phylogenetically akin; and consequently have a direct bearing upon the conception of progressive chemical specialization of the nervous ystem.

13. Electrical polarity in Obelia. E. J. Lund, University of Minnesota.

A definite difference of electrical potential occurs in the stem of the colony of Obelia, such that the apical growing region is electronegative to the middle or more basal region. This electrical polarity is associated with the living tissue of the coenosarc and does not originate in any other structure of the stem for on potential difference occurs in: *a*) stems left to die and macerate in sea water; *b*) stems from which the living tissue has been removed mechanically, and, *c*) stems in which the living tissue has been killed by chloroform. The magnitude of the fall of potential varies in pieces of stems from different colonies. It also varies along the length of the stem of the same colony, being greatest in the apical actively growing region. The general conclusion from the experiments is that, since normally inherent differences of electrical potential occur in the stem of Obelia and are associated with apical growth, then it should be possible to inhibit or modify developmental processes by appropriate application of an E. M. F. of external origin. This was shown to be possible in the previous paper reported to this society a year ago.

14. Circus movements in negatively heliotropic Limax. W. J. Crozier and W. H. Cole, Rutgers College and Lake Forest College.

Analyses are already available of circus-movements executed by positively heliotropic organisms under suitable conditions, and the significance of these movements for the theory of heliotropism is generally recognized. We are able to show that in the negatively heliotropic slug Limax, with non-directive illumination, the animal circles continuously toward that side on which tip of the eye-tentacle (including the eye) has been removed. The diameter of the circular path varies inversely with the light intensity. It is found that the eyes, or structures in their immediate vicinity, are the effective receptors; upon regeneration of the eye following unilateral amputation, there is progressive return of typical orientation.

15. The effect of chemicals on locomotion in Ameba. I. Reactions to localized stimulation. J. Graham Edwards (introduced by S. O. Mast), The Johns Hopkins University.

Localized stimulation was obtained by allowing various chemicals to diffuse from a capillary pipette against the surface of the ameba. The response depends

upon the composition of the medium in which the ameba is when stimulated. The following results were obtained from observations of specimens in N/500 KCl. In this solution they travel uniformly and monopodally. Acids (N/5 to N/500) cause a violent positive response. A protuberance is formed at the point stimulated which persists until incorporated in the folds at the posterior end; in lower concentrations, a small pseudopod is initiated which, however, does not persist. The response is in all cases more immediate and larger the nearer the anterior end the stimulus is applied, being negligible at the posterior end. The effect apparently depends on a local swelling of the ectoplasm with subsequent gelation. Hydroxides (N/5 to N/500) cause a broad sheet of protoplasm to flow toward the pipette, after which streaming continues in another direction. In lower concentrations, a small pseudopod is formed but does not persist. The effect here, as in acids, seems dependent on swelling of the ectoplasm, but without subsequent gelation. Salts induce various responses depending on their concentration and composition. Local changes in permeability seem to condition these responses. Alkaloids and non-electrolytes induce negative responses. If the leucobase of methylene blue is applied anteriorly, the endoplasmic flow stops and the ectoplasm wrinkles at the point of application. If applied laterally, an indentation is formed at the point of application and the ameba becomes crescent-shaped.

16. A quantitative study of the reactions to light in Amoeba. Harry T. Folger (introduced by S. O. Mast), The Johns Hopkins University.

Amoeba reacts to sudden increase in illumination by complete cessation of movement. The time from the beginning of stimulation until this cessation occurs varies with the intensity of the light. It becomes shorter as the intensity increases. The decrease in reaction-time, however, is not proportional to the increase in intensity. The amount of light-energy (meter-candle-seconds) received during the reaction-time is greater in higher than in lower intensities. To secure a response, exposure for only a definite portion of the reaction time is necessary, the reaction taking place at precisely the same time as if the illumination had been continued. Thus the reaction-time may be divided into two parts: *a*) a stimulation-period during which the animal must be exposed to light to get a response; *b*) a latent period during which exposure is not necessary. The latent period varies greatly in different animals, under the same environmental conditions. Usually it is practically constant in any individual for a moderate length of time. However, there are occasional fluctuations which sometimes take place gradually but which may occur suddenly. Such changes in the latent period amount in some cases to more than 100 per cent and are apparently independent of any change in the environment. The stimulation-period varies inversely with the intensity of illumination. The light energy received during this period is constant. Dark adaptation is necessary for a response. This process usually requires less than one minute.

17. The influence of temperature on the rat of locomotion in Amoeba. Alphonse M. Schwitalla (introduced by S. O. Mast), St. Louis University.

The relation between temperature and the rate of locomotion in Amoeba was studied quantitatively by means of a modified Pfeiffer stage and thermocouples.

At constant temperatures there are alternate periods of acceleration and retardation in the rate of locomotion. These periods are readily interpretable as phases in a locomotor rate-rhythm. They are coincident with eruptive and quiescent periods of activity as manifested by the rate of flow in the endoplasm. The relation between the two phases is constant under certain conditions but not under others. The average rate of locomotion increases with a rise in temperature until a maximum is reached at about 25°, after which it decreases. The value of the van't Hoff temperature coefficient (Q_{10}) for a given individual under different conditions is extremely variable, but not more so than it is for certain other physiological processes. The evidence points to the conclusions that there is no direct quantitative relationship between temperature and the rate of locomotion, and that temperature affects the rate of locomotion only through its effect on the rhythmical processes which condition locomotion.

J. UNCLASSIFIED

1. The National Research Council Information Service. ROBERT M. YERKES.

Under this title is offered a brief account of the informational clearing-house for science and technology which is being developed by the National Research Council. The 'Service' is maintained with the cooperation of investigators and for their use. Ordinarily they may consult it without charge. The organization will serve also to disseminate intelligible and reliable information concerning scientific research and the applications of its results. All who are interested in research or its products are invited to make use of the Research Information Service.

ADDITIONAL ABSTRACTS

The following abstracts were received too late to be included in the Abstracts printed before the meeting. The Society voted to receive these and ordered them printed as a part of the proceedings of the meeting. Six of the papers were presented in full at the meetings.

A′. 25. *A lethal gene which changes the order of the loci in the chromosome map.* H. J. MULLER, University of Texas. Abstract too long to be printed.

C. 9. *The spermatogenesis of man.* THEOPHILUS S. PAINTER, University of Texas.

A study has been made on the spermatogenesis of man using testicular material (from two negroes and a white man) which was perfectly fresh when preserved. The main results are as follows:—there are 48 chromosomes in dividing spermatogonia in both the white and the negro testes. Two of these 48 chromosomes have no synaptic mates of the same size or shape. These are the X and Y sex chromosomes. Primary spermatocytes show 24 chromosomes. The X-Y sex chromosome consists of an element, the two halves of which are very unequal in size. When division occurs, the X chromosome goes to one pole, and the Y to the other.

C. 10. *The spermatogenesis of the opossum.* THEOPHILUS S. PAINTER, University of Texas.

The complete spermatogenesis of the opposum has been worked out, the points of main interest being, (a) the diploid or somatic chromosome number is 22. (Previous investigators have reported 17 and 24.) Two of these have no synaptic

mates of the same size and shape. They are the X and Y sex chromosomes. The X and Y components segregate to opposite poles during the first maturation division, hence half the sperm carry an X and half a Y sex-chromosome. A study of embryos confirmed the above conclusions.

E. 10. *Notes on the Crocodilia of British Guiana.* Albert M. Reese, University of West Virginia.

Of the four species of Caiman described from British Guiana probably only one, C. niger, is dangerous to man, though native hunters consider all of the so-called "alligators" dangerous.

Since their hides are not suitable for leather the caimans are not subject to the chief source of danger that has thinned the ranks of the Florida alligator, but they are fairly scarce in some parts of the colony, while very abundant in other parts.

They are extensively killed, on some sugar estates, though it is doubtful if they are not more beneficial as destroyers of rodents than harmful in other ways.

Their nests resemble in form and location those of the Florida alligator, but are often built of finer and entirely "dead" vegetable material.

The eggs are usually smaller (those of C.niger were not found) and have usually, though not always, rougher, harsher shells than the eggs of the Florida alligator. The average number of eggs per nest is about 27. About 6 per cent of the eggs examined were infertile. The eggs are mostly laid in the late spring, and hatch in two or three months, the period of incubation probably varying with conditions of temperature, moisture, etc.

E. 11. *A noteworthy adaptive modification of the webs of a siamese argiopid spider.* Henry E. Crampton, Barnard College.

Along the railroad through the jungles of southern Siam, the telegraph wires provide spaces of varying width in which Argiopid spiders construct their webs. The animals probably belong to the genus *Nephila*. Full-sized webs are built where the intervals are suitable. When the interspaces are less than the diameter of a normal web, the spiders modify the structures by omitting an upper sector of greater or less extent, according to an invariable mode of adjustment.

E. 12. *On the distribution and ecology of the species of Partula inhabiting the Mariana Islands of the Western Pacific Ocean.* (Illustrated with lantern-slides and specimens.) Henry C. Crampton, Barnard College.

In the course of a recent journey, the species of *Partula* inhabiting Guam and Saipan were investigated, as in earlier studies in Polynesia proper. The general principles of distribution were confirmed, as regards inter-island and, intra-insular differentiation. The environmental influences, as such, are not determinative with reference to the distinctive characters of distinguishable species and subordinate varieties.

H. 23. *Phases in the life-history of a holostome, Cyathocotyle Orientalis, nov. spec., with notes on the excretory system of the larva.* Ernest Carroll Faust, Parasitology Laboratory, Department of Pathology, Peking Union Medical College, Peking, China.

1. A larval holostome, Tetracotyle orientalis, nov. spec. is described from Peking, China.

2. The excretory system of the tetracotyle consists of two parts, a close network of canals with granular inclusions (the reserve bladder), and the system of tubules, capillaries and flame-cells.

3. The analysis of the excretory system of the tetracotyle shows a development along an exact plan, with five main tubules on each side of the body, each tubule draining a system of 32 dorsal and 32 ventral capillaries and flame-cells. Each of these sub-systems is based on a 5-fold dichotomy. The formula $\alpha + \beta + \gamma + \text{il} + \epsilon$ exactly fits such a system. In the adult worm there will probably be an exact multiple of this least common denominator.

4. Of six young ducks carefully examined for infection beforehand, one was used for experimental feeding with the tetracotyliform larvae. Twelve days after the feeding the experimental animal died and at autopsy 75 holostomes were recovered from the ceca. The controls were all negative. The worms are believed to be responsible for a diarrhoeic and possibly dysenteric involvement of the ceca.

5. Some of the worms recovered from the experimental host were adults while others were immature. Study of the adults showed the worms to belong to the genus Cyathocotyle. The species is new and is designated as Cyathocotyle orientalis.

6. Comparison of tetracotyle, immature and adult worms indicates the progressive changes involved in its growth and gives an insight into certain relationships of the genus and of the group.

I. 19. *The instincts and adaptations of several species of Tortugas fishes.* W. H. Longley, Goucher College, Baltimore.

The local distribution of many species of fishes is determined by the character of the bottom. This is particularly true of what may be called the "sand-patch association," members of which require a substratum of a peculiar character in which they may hide temporarily or construct convenient shelters. Opisthognathus and Gnathypops inhabit vertical burrows, sometimes a foot and a half deep and lined with bits of coral and shell as well are lined with brick. Toglossus has unlined burrows more irregular in shape. Xyrichthys simply buries itself in the sand when alarmed although there is reason to believe that after its excursions in the open it may return again and again to one place.

Thalassoma nitidus is commonly seen pecking at the surface of larger fishes presumably cleaning ectoparasites from them. These larger fishes return again and again to submit to the process of grooming and will drive away others which interrupt the process.

This Thalassoma, whose attentions are not merely tolerated but actually welcomed, is resembled in a striking way by a small blenny, which although rare occurs with it and is notably different from the other blennies in respect to certain reactions which accentuate its superficial resemblance to Thalassoma. The relation between the two species appears comparable to a certain extent with the so-called 'Batesian mimicry.'

Slides were used to show peculiarities of form and behaviour of members of the sand-patch association" and Thalassoma in action. Others illustrated the obliterative effect of the changeable coloration of common species of reef-fishes.

I. 18. *The reflex produced by chemical stimulation of the deeper respiratory passage.* E. Horne Craigie, Department of Biology, University of Toronto.

The respiratory and circulatory reflexes aroused by the projection of an irritant vapour into the trachea, bronchi, and lungs have been stated by certain observers to be obliterated by double vagotomy, and by others to be unaffected by this operation.

The respiratory response obtained in dogs is found to consist of increased expiratory effort and an inhibition of inspiration.

The vaso-motor response consists of a rather gradual fall in blood-pressure, followed at once by a somewhat slower return to normal. In some cases the fall was preceded by a slight, brief rise in pressure.

Both the respiratory and the circulatory reflexes are entirely unaffected by section of both vagi, which therefore cannot contain the afferent fibers concerned.

I. 20. *Hen feathering induced in male fowls by feeding thyroid.* Benjamin Horning and Harry Beal Torrey, University of Oregon Medical School.

When fed thyroid daily, in doses increasing with their weight, from the age of three weeks, our male Rhode Island Red chicks developed plumage of the female type, although males of this breed ordinarily do not pass through a juvenile stage characterized by plumage of the female type. The plumage of capons, usually ultra male, is not affected by thyroid feeding. Castrated females which typically develop male plumage are similarly unaffected. The primary effect of the tyroid feeding seems to be to increase the activity of the 'lutear' interstitial tissue of the testis. The end result is a hen feathered male resembling in all essential characteristics of the plumage the hen feathered males of the sea-bright bantam and campine breeds.

AMERICAN SOCIETY OF ZOÖLOGISTS

CONSTITUTION, OFFICERS AND LIST OF MEMBERS OF THE SOCIETY

CONSTITUTION

Article I

NAME AND OBJECT

Section 1. The Society shall be called the "American Society of Zoölogists."

Sec. 2. The object of the Society shall be the association of workers in the field of Zoölogy for the presentation and discussion of new or important facts and problems in that science and for the adoption of such measures as shall tend to the advancement of zoölogical investigation in this country.

Article II

MEMBERSHIP

Section 1. Members of the Society shall be elected from persons who are active workers in the field of Zoölogy and who have contributed to the advancement of that science.

Sec. 2. Election to membership in the Society shall be upon recommendation of the Executive Committee.

Sec. 3. Each member shall pay to the Treasurer an annual assessment as determined by the Society. This assessment shall be considered due at the annual meeting and the name of any member two years in arrears for annual assessments shall be erased from the list of members of the Society, and no such person shall be restored to membership unless his arrearages shall have been paid or he shall have been re-elected.

Sec. 4. Foreign Zoölogists, not members of this Society, may be elected Honorary Fellows upon unanimous recommendation of the Executive Committee by a majority vote of the members present at any meeting of the Society. Honorary Fellows shall not be required to pay dues.

Article III

OFFICERS

Section 1. The officers of the Society shall be a President, a Vice-President, a Secretary and a Treasurer and the members at large of the Executive Committee.

Sec. 2. The Executive Committee shall consist of the President, the Vice President, the Secretary, the Treasurer and five members elected from the Society at large. Of these five members, one shall be elected each year to serve five years. If any member at large shall be elected to any other office, a member at large shall be elected at once to serve out the remainder of his term.

Sec. 3. These officers shall be elected by ballot at the annual meeting of the Society and their official terms shall commence with the close of the annual

meeting, except that the Secretary and the Treasurer shall be elected triennially and shall serve for three years.

Sec. 4. The officers named in Section 1 shall discharge the duties usually assigned to their respective offices.

Sec. 5. Vacancies in the board of officers, occurring from any cause, may be filled by election by ballot at any meeting of the Society. A vacancy in either the Secretaryship or the Treasurership occurring in the interval of the meetings of the Society may be filled by appointment, until the next annual meeting, by the Executive Committee.

Sec. 6. At the annual meeting the President shall name a nominating committee of three members. This committee shall make its nominations to the Secretary not less than one month before the next annual meeting. It shall be the duty of the Secretary to mail the list of nominations to all members of the Society at least two weeks before the annual meeting. Additional nominations for any office may be made in writing to the Secretary by any five members at any time previous to balloting.

Article IV

Meetings of the Society

Section 1. Unless previously determined by the Society the time and place of the annual meeting of the Society shall be determined by its Executive Committee. Special meetings may be called and arranged for by the Executive Committee. Notices of such meetings shall be mailed to all members of the Society at least two weeks before the date set for the meeting.

Sec. 2. Sections of the Society may be organized in any locality by not less than ten members, for the purpose of holding meetings for the presentation of scientific papers. Such sections shall have the right to elect their own officers and also associate members; provided, however, that associate membership in any section shall not confer membership in the Society.

Article V

Quorum

Twenty-five members shall constitute a quorum of the Society and four a quorum of its Executive Committee.

Article VI

Changes in the Constitution

Amendments to this Constitution may be adopted at any meeting of the Society by a two-thirds vote of the members present, upon the following conditions:

(a) The proposed amendment must be in writing and signed by at least five members of the Society.

(b) This signed proposal must be in the hands of the Secretary at least one month before the meeting of the Society at which it is to be considered.

(c) The Secretary shall mail copies of the proposed amendment to the members of the Society at least two weeks before the meeting.

BY-LAWS

DUES

(1) The annual dues for members, unless remitted or changed by the vote of the Society, shall be seven dollars.

SECRETARY

(2) The duties and privileges of the Secretary shall be as follows:

(a) He shall keep the records of the Society.

(b) Whenever the proper officers of a number of related societies shall have a conference with a view to determining a common time and place for the several annual metings, he shall act as the delegate or representative of this Society. (See also 5.)

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society, and

(d) He shall be reimbursed out of the funds of the Society for expenses incurred in attending meetings of the Society.

TREASURER

(3) The duties and privileges of the Treasurer shall be as follows:

(a) He shall be in charge of the funds of the Society.

(b) At the Annual Business Meeting of the Society he shall present a statement to date of the funds of the Society.

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society.

AUDITING COMMITTEE

(4) The President shall annually appoint an auditing committee of two, who shall audit and report upon the financial record and statement of the Secretary-Treasurer at the meeting for which they were appointed.

(5) The National Research Council allows the Society three representatives on the Division of Biology and Agriculture. Of these three representatives, one shall be elected each year to serve three years. The method of election shall be the same as that used in the election of the officers of the Society.

MEETINGS

(6) It shall be the policy of the Society to hold meetings in both Eastern and Central-Western territory, and the distribution of the meetings between the two territories shall be determined in general on the basis of the representation of Eastern and Western members in the Society. See also 2-c.

PROGRAM RULES

(7) In matters relating to programs for annual meetings the following rules shall be observed:

(a) Papers shall be listed and presented according to subject matter in the following groups: 1. Comparative Anatomy; 2. Embryology; 3. Cytology; 4.

Genetics; 5. Comparative and General Physiology; 6. Ecology, and 7. Miscellaneous, or other groups at the discretion of the Secretary-Treasurer.

(b) Whenever conditions require it the Executive Committee shall schedule two or more groups for the same hour and rearrange the program to bring together papers on subjects of more general interest for meetings of the whole Society. The Committee, however, is instructed to avoid conflicts as much as possible.

(c) Papers shall be listed in their respective groups in the order received. When a member offers more than one paper those following the one designated first shall be placed at the end of the list and shall not be read until all first papers by members shall have been twice called for.

(d) All papers not read when called for as listed shall be placed at the end of the group list, and, if not read when called for the second time, they shall be read by title only.

(e) The titles of "introduced" papers shall be listed in the groups after the titles of papers to be read by members. Such papers shall be read by title only in case the entire program cannot be completed during four regular sessions for reading papers.

(f) Fifteen minutes shall be the maximum time allowed for the presentation of a paper.

(g) Abstracts of papers for publication in the proceedings of the Society must be handed to the Secretary-Treasurer or his representative before final adjournment of the annual meeting.

HISTORICAL REVIEW

A review of the historical antecedents of the present American Society of Zoölogists will be found in *The Anatomical Record* for January, 1917. The list of officers and meeting places of the present Society found in the same place is brought up to date and reprinted here.

LIST OF FORMER OFFICERS

American Morphological Society

President	*Vice-President*	*Secretary-Treasurer*
1890—E. B. Wilson	.....	J. P. McMurrich
1891—C. O. Whitman	E. L. Mark	J. P. McMurrich
1892—C. O. Whitman	H. F. Osborn	J. P. McMurrich
1893—C. O. Whitman	E. B. Wilson	J. P. McMurrich
1894—C. O. Whitman	W. B. Scott	G. H. Parker
1895—E. B. Wilson	W. B. Scott	G. H. Parker
1896—E. L. Mark	H. F. Osborn	G. H. Parker
1897—C. S. Minot	S. I. Smith	G. H. Parker
1898—H. F. Osborn	T. H. Morgan	G. H. Parker
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1894—Baltimore
1895—Philadelphia
1896—Boston
1897—Ithaca
1898—New York
1899—New Haven
1900—Baltimore
1901—Chicago
1902—Washington

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1899—Chicago
1900—Chicago

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1901—Chicago
1902—Washington

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[1] The data given in this list is based on the last preceding list published in *The Anatomical Record*, Vol. 20, No. 2, with such corrections and additions as have come to the attention of the Secretary. Please notify the Secretary of errors in this copy of the membership list that they may be corrected in the next published list.

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